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ABSTRACT

This guide provides model learner outcomes used by communities and schools to improve learning experiences in trade and industrial education. It contains a mission statement for public education in Minnesota and 13 learner goals that must be incorporated into each district's goal statements. The bulk of this document contains model learner outcomes for 15 trade and industrial occupations. Each learner outcome is accompanied by state board learner goals and development/concept emphasis. Learner outcomes for students in grades 6 through 10 are identified in communication, energy and power, production, and transportation. In addition, general and gifted/talented outcomes are outlined. Eleven areas of specialization for grades 11 and 12 are as follows: (1) architectural drafting occupations; (2) automotive technician occupations; (3) carpentry occupations and finishing trades; (4) construction occupations; (5) electronics occupations; (6) graphic communication occupations; (7) machining occupations; (8) mechanical drafting occupations; (9) small engine repair occupations; (10) technology cooperative programs; and (11) welding occupations. General outcomes for all grades 11 and 12 areas are also included. The guide includes a section on transposing outcomes into the curriculum. Three forms for curriculum development and 12 references are included. (NLA)

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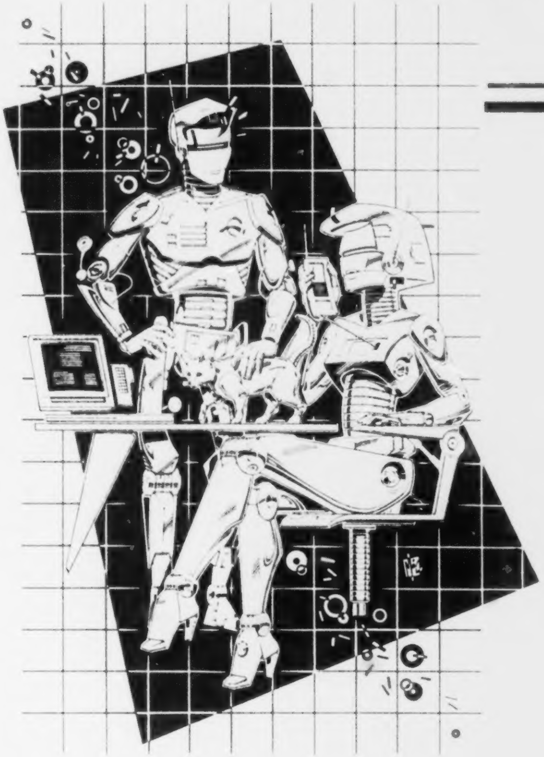

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Technology Education/Industrial Technology

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TABLE OF CONTENTS

Chapter 1

Minnesota State Board of Education

Values, Philosophy, Mission, Goals .... Page 3

Chapter 2

Introduction and Goals

Program Level Learner Outcomes .... Page 19

Chapter 3

Model Learner Outcomes .... Page 25
- Communication 28
- Energy and Power Use 31
- Production 35
- Transportation 39
- General Outcomes 41
- Gifted/Talented Outcomes 41
- Architectural Drafting Occupations 42
- Automotive Technician Occupations 47
- Carpentry Occupations and Finishing Trades 56
- Construction — General 60
- Electronic Occupations 65
- Graphic Communication Occupations 74
- Machine Shop 80
- Mechanical Drafting 85
- Small Engine Repair Occupations 89
- Technology Cooperative Program 98
- Welding Occupations 103
- General Outcomes for All Areas 108

Chapter 4

Transposing Into the Curriculum .... Page 111

Bibliography 129

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Chapter 1

Technology Education/ Industrial Technology

Minnesota State Board of Education

Education Values, Learner Values

Philosophy, Mission and Goals

Chapter 1

Minnesota State Board of Education

Values, Philosophy, Mission, and Goals

School districts nationwide, and certainly in Minnesota, are constantly striving to improve the learning experiences they provide students. The last two or three decades have seen heightened interest in improving all parts of the education process, including appropriate involvement of students, parents, and the community at large.

The documents that constitute the Minnesota Department of Education's *Coordinated Model for Educational Improvement* incorporate many of the concerns expressed and issues addressed by the public, Legislature, and in reports on the state of public education. One of these documents, titled *Goal and Outcome Specification Process,* suggests a set of procedures for appropriate involvement of the public. These procedures include public participation on the development of statements of values, philosophy, mission, and learner goals. These sets of statements are a hierarchy of increasingly specific concepts ranging from values, the most general, to learner goals, the most specific, that give form and direction to public education. Given this hierarchy, staff skilled in subject matter and the profession of teaching can develop very specific learner outcomes for each subject area.

The following sets of statements were adopted by either the Minnesota State Board of Education or the Minnesota State Legislature for two purposes. First, they provide a model for use by communities and school staff as they strive to improve the learning experiences they provide for residents. Second, they are the hierarchy used by Department staff and teams of educators as they develop model learner outcomes for each subject area. The *Mission Statement for Public Education* adopted by the Legislature gives explicit direction to public schools. The State Board Curriculum Rule 3500.1060 adopted February 1990 lists the learner goals which must be incorporated into each district's goal statements. All other parts of this document are models, suggestions for the consideration of residents and professionals in each district.

Education System Values

We believe the following values are preeminent for the education system. These attributes are to be reflected in all educational programs and operations.

Accountability – A condition in every school whereby each is able to justify its use of public resources by effectively fulfilling its mission of learning.

Effectiveness – A condition in every school whereby each accomplishes its mission at a performance level defined by learners, parents, citizens of the community and state, and their representatives.

Efficiency – A condition in every school whereby each accomplishes the highest possible level of excellence with available resources.

Excellence – A condition in every school whereby the highest possible standards for performance are expected of all students and staff.

Flexibility – A condition in every school which results in meeting the needs of learners through sensitive and creative responses to changing circumstances.

Human Equity – A condition in every school which offers equal opportunity and appropriate individualized support to each staff member in employment and professional growth and to each learner in the educational process. Also, a condition which fully, fairly, and accurately portrays various cultures, races, and genders in the instructional program.

Responsibility – A condition in which the school recognizes that the parent has primary responsibility to assure the child is educated, and in which a partnership exists between the school, community, parent, and the learner to identify the learning goals and needs of the child or adult learner and provide appropriate learning opportunities through which those goals can be met.

Responsiveness – A condition in every school whereby diversity of personal and group needs and aspirations are expected, accepted, encouraged, and routinely addressed.

System Equity – A condition in the education system whereby each school is provided with the resources necessary to assist all learners in achieving excellence.

Wholeness – A condition in every school whereby each gives necessary and appropriate consideration to the potential career needs, spiritual, social, emotional, and physical growth of each learner and staff member as it designs and implements educational programs.

Visionary – A condition in the education system whereby emerging trends which will affect the knowledge and skills required to be a successful adult are examined and the knowledge gained is used to produce appropriate changes in the system's course content, procedures, and goals for learners.

Learner Values

We believe helping students develop the following values is a primary purpose of education.

Accountability – A quality in individuals whereby each knows, understands, and accepts the impact and consequences of personal actions and decisions.

Citizenship – A quality in individuals whereby each has an understanding, appreciation, and support of the institutions of American government and society, and a willingness and ability to participate in the democratic process and in socially beneficial service activities.

Compassion – A quality in individuals whereby each is sensitive to the conditions affecting the lives of others and each has the commitment to assist others when appropriate and possible.

Competence – A quality in individuals whereby each attains maximum levels of knowledge, skill, and affect commensurate with his or her potential.

Cooperativeness – A quality in individuals whereby each interacts with others in a manner that mutually benefits all participants in the interaction.

Creativity/Flexibility – A quality in individuals whereby each acts or expresses self in new, improved, or unique ways.

Ethics – A quality in individuals whereby each displays consistent personal and professional integrity and an acceptance of the responsibility to act for the benefit of all learners.

Honesty – A quality in individuals whereby each is fair and straightforward in the conduct of human interaction.

Learning – A condition in individuals whereby each continually strives throughout life to learn more and to increase personal levels of fulfillment and competence in human endeavors.

Problem Solving – A condition in individuals whereby each has the ability to identify, frame, and propose new, improved, or unique solutions to existing and emerging problems.

Responsibility – A quality in individuals whereby each strives to fulfill the obligations of economic self–sufficiency and active commitment to the common good of society.

Self–Acceptance – A quality in individuals whereby each has a positive self–image, through assertion of rights, holding personal, physical, and emotional well–being as an ideal, accepting personal talents with humility, and personal limitations with the resolve to improve where possible and accept where necessary.

Spirituality – A quality in individuals whereby each recognizes and accepts the importance of nurturing one's inner spirit, that creative force that transcends the human and the material.

Thinking – A condition in individuals whereby each continually strives to improve personal skills for mental manipulation of sensory perceptions to form knowledge, thoughts, reason, and judgments.

Minnesota State Board of Education
Philosophy of Education

We Believe . . .

. . . Every person can learn.

. . . Learning is a lifelong process.

. . . Every person must understand and accept self before he or she can become a contributing member of society.

. . . Each person has gifts which the education program must seek, identify, and help to maximize.

. . . Advancement of the human race requires individuals who are honest, responsible, compassionate, cooperative, creative, and competent.

. . . The state and local communities have a shared responsibility to assist each person in learning.

. . . Each community has a shared responsibility with parents for meeting the needs of each child.

. . . The community and its school system must continually look to and strive to meet the future education needs of society.

. . . The education system must assist each person to become functional in an increasingly global and interdependent world.

. . . The education system must lead people to value and accept a wide diversity in human behaviors, sophistication, and values.

. . . The education system must maintain high standards for responsiveness, human equity, and system equity in the provision of educational opportunities.

. . . Decisions regarding planning, implementing, and maintaining learning opportunities must be vested as close to the individual learner as efficient use of public resources allow.

. . . School systems must implement programs that stress the intellectual development of each learner in concert with the spiritual, social, emotional, and physical development of the learner.

. . . School systems must model and nurture creativity in learners.

. . . School systems must maintain opportunities for all learners to develop competence in personally selected areas of human development.

. . . Professional educators have a responsibility to remain current with evolving knowledge about human growth and development, learning theory, and knowledge of subject matter.

. . . Professional educators and elected or appointed education policymakers have a responsibility to account to the public for the excellence of their efforts.

. . . Professional educators and elected or appointed education policymakers have a responsibility to use public resources prudently and efficiently.

. . . Staff employed in schools must model the behaviors they are assisting learners to develop.

Mission for Public Education

As adopted by the Minnesota Legislative Commission on Public Education and enacted into law, Chapter 240, Laws of 1985

The purpose of public education is to help individuals acquire knowledge, skills, and positive attitudes toward self and others that will enable them to solve problems, think creatively, continue learning, and develop maximum potential for leading productive, fulfilling lives in a complex and changing society.

Mission of the Minnesota State Board of Education

The Minnesota State Board of Education will provide the vision, advocacy, and leadership to improve significantly the quality of education throughout the state.

Mission of the Minnesota Department of Education

The Minnesota Department of Education provides leadership, service, and regulation to maintain and improve an equitable, uniform, and quality system of public education for all learners.

The Department provides leadership as an advocate for education by defining quality education and by seeking the resources necessary to meet the needs of all learners.

The Department provides service through informational and technical assistance that will improve the productivity and performance of students and staff, and provide opportunities for the development of the potential of all learners.

The Department regulates education by maintaining, interpreting, and enforcing Minnesota State Board of Education rules, and state and federal laws.

Minnesota State Board of Education

Learner Goals

Learner goals are a series of statements that describe the knowledge, skill, processes, values, and attitudes that a learner can expect to achieve as a result of active participation in K–12 public education. They are based on the presumed current and future intellectual, social, emotional, physical, and career/vocational needs of students and adults in contemporary society.

Each district shall use the learner goals contained below as the basis for defining program–level learner outcomes that are directly reflected in the district's course and program offerings.

A. To effectively participate in learning activities, each learner will:

1. master reading literacy to gather information and data, gain perspective and understanding, and as a leisure activity;
2. master writing to explain, describe, and express a point of view and feelings;
3. master listening to gather information and data and gain perspective and understanding;
4. master speaking to explain, describe, express a point of view and feelings, and to discuss an issue;
5. master numerical literacy to apply mathematical functions to life situations;
6. master the use of a variety of tools, including electronic technology, to enhance learning;
7. master viewing and observing to gather information and data, and gain perspective and understanding; and
8. apply skills in self–expression through visual and performing arts.

B. To provide a foundation for meaning in life, each learner will accumulate and apply knowledge and develop the understanding to:

1. participate in lifelong learning;
2. live within local, state, national, and world political and social structures;

3. examine personal beliefs and values and their relationship to behavior;
4. make ethical and moral decisions;
5. be a responsible citizen of the community, nation, and the world;
6. practice stewardship of the land, natural resources, and environment;
7. know the impact of human life on nature and the impact of natural phenomena on human life;
8. express self through artistic creation;
9. know career options and the general education requirements for each;
10. know world and national economic conditions to make informed decisions on consumer products, occupations and career needs, and use of resources;
11. select or prepare for a series of occupations that will personally satisfy and suit one's skills and interests;
12. manage personal affairs;
13. understand the physical world using systematic problem-solving strategies:
14. communicate and relate effectively in a language and about a culture other than one's own; and
15. know the importance of geographic location in the functioning of contemporary society.

C. To think, decide, resolve issues, and meet needs creatively, each learner will be able to:

1. compare, differentiate, and relate information and facts and apply knowledge;
2. combine various facts, situations, and theories to formulate new and original hypotheses or to develop new solutions;
3. critique and make judgments about materials, conditions, theories, and solutions;

4. generate and value creative alternatives; and
5. apply the concepts and processes of science.

D. To value, understand, and accept human interdependence, each learner will be able to:

1. seek interactions and feel comfortable with persons who are different in race, religion, social level, or personal attributes;
2. understand the basic interdependence of the biological and physical resources of the environment;
3. understand the interrelationships among complex organizations and agencies in modern society;
4. understand how the citizens of the United States are geographically and socially connected to people and places in other parts of the world.

E. To value, understand, and accept the diversity of humankind, each learner will be able to:

1. base actions and decisions on the knowledge that individuals differ in many ways;
2. base actions and decisions on the knowledge that values and behaviors differ from one social group to another;
3. base actions and decisions on the understanding that lifestyles and behaviors reflect the value system of the societies in which they were learned;
4. judge other's actions with an understanding of the personal and social context of that action;
5. accept that there is more than one way of being human;
6. base actions and decisions on the understanding that as individuals move from one society to another they can learn lifestyles and can learn to behave appropriately in different social contexts; and
7. act on the belief that human behavior is influenced by many factors and is best understood in terms of the context in which it occurred.

F. To address human problems through group effort, each learner will develop the knowledge, skills, values, and attitudes essential to:

   1. act in accordance with a basic ethical framework incorporating the values that contribute to successful community life such as honesty, fairness, compassion, and integrity;

   2. understand the importance of working in groups to achieve mutual goals; and

   3. be able to provide leadership in resolving personal and societal issues.

G. Each learner will be able to effectively resolve conflicts with and among others by:

   1. assuming responsibility to form productive and satisfying relationships with others based on respect, trust, cooperation, consideration, and caring for other persons;

   2. acting on the belief that each individual has value as a human being and should be respected as a worthwhile person; and

   3. resolving conflict in the manner most beneficial to society.

H. Each learner will be able to act on contemporary events and issues with a perspective of their historical origins:

   1. understanding the origins, interrelationships, and effect of beliefs, values, and behavior patterns in world cultures;

   2. understanding one's own culture and historical heritage through the literary, aesthetic, and scientific traditions of the past;

   3. being familiar with the ideas that have inspired and influenced humankind; and

   4. understanding the manner in which heritages and traditions of the past influence the direction and values of society.

I. Each learner will develop a positive attitude toward self, demonstrated through:

   1. a feeling of positive self–worth, security, and self–assurance;

2. a willingness to live with one's strengths and weaknesses;

3. a basic understanding of one's own body, its systems and physiology, and a positive attitude toward one's own physical appearance;

4. understanding that efforts to develop a better self contribute to the development of a better society;

5. understanding that self–concept is acquired by interaction with other people; and

6. appropriate control or release of emotions.

J. To set and achieve personal goals, each learner will develop the ability to:

1. select appropriate personal learning goals;

2. make decisions about one's life;

3. plan, act, and organize to realize one's goals;

4. accept responsibility for personal decisions and actions;

5. work now for goals to be realized in the future; and

6. select viable alternatives for actions in changing circumstances.

K. To cope with change, each learner will develop the ability to:

1. initiate appropriate change while respecting existing structures and concepts;

2. tolerate ambiguity;

3. understand that coping with change is a lifelong process;

4. understand and accept the changing nature of work and the potential need to change careers several times;

5. use career information and counseling services to make informed and satisfying vocational choices; and

6. understand that all knowledge is tentative and that as new discoveries are made the knowledge base grows.

L. To lead a healthy and fulfilling life, each learner will:

1. assume responsibility for one's own physical and mental health and safety by establishing a daily regime of health behaviors that will maintain mental and physical health and motor fitness;
2. make informed decisions about health products and services;
3. make a lifestyle that promotes healthful family living;
4. understand public health measures and their effect on the individual, family, community, and environment; and
5. be able to enjoy play–skill activities that include understanding, cooperation, accepting rules, controlling emotions, following group process, and acquiring self–satisfaction.

M. To lead a productive life and actively contribute to the economic wellbeing of our society, each learner will develop the work readiness skills of:

1. applying the basic skills of communications, computation, and scientific principles to real–life situations in a technological society;
2. defining and interpreting the nature of the work force in terms of one's own challenges and opportunities;
3. leadership and citizenship necessary to succeed as an active agent in a changing work force;
4. understanding employment opportunities, job seeking and keeping, and specific work as they relate to transition from school to economic productivity;
5. developing pride in good work and expecting quality in products and services; and
6. adopting a positive attitude toward work, including the acceptance of the necessity of making a living and an appreciation of the value and dignity of work.

Chapter 2

Technology Education/ Industrial Technology

Introduction

Goals

Program Level Learner Outcomes

Chapter 2

The world is on the edge of a major lifestyle, business, industry, and educational upheaval – an upheaval which will be fueled by rapid technological growth and by a very competitive worldwide marketplace. This upheaval brings with it major threats and opportunities to the business and economic base of the United States – all of which is predicated on the technological literacy of our citizens.

Because the American culture is distinctly characterized as technological, it becomes the function of our educational system to provide every student an insight and understanding of the technological nature of our culture. All persons must be knowledgeable of their technological environment so they can make rational decisions about their own lives on a day-to-day basis and participate in controlling their own destiny.

Taken from Technology: A National Imperative.
A Report to the Technology Education
Advisory Council.

We live in an increasingly technological society. A process for teaching young people about that world has of necessity evolved, and is a legitimate function of the schools. Hence, names such as manual training, manual arts, industrial arts, industrial education, industrial technology, trade and industrial education, and technology education have evolved to describe those efforts.

A previous document which described learner outcomes for this field of study was titled *Model Learner Outcomes for Industrial Arts / Industrial Technology Education.* Just as technology changes rapidly, names must evolve to appropriately reflect content and emphasis. Professional associations at the state and national level have made name changes, as have curriculum materials and official documents in more than 30 states.

A highly regarded study titled *A Project 2061 Panel Report: Technology* was recently completed by the American Association for the Advancement of Science (AAAS). The report defines technology as **the application of knowledge, tools, and skills to solve practical problems and extend human capabilities.** The report further defined technology to include the following sample areas: 1) materials, 2) energy, 3) manufacturing, 4) agriculture and food, 5) biotechnology and medical technology, 6) environment (atmosphere), 7) communications, 8) electronics, 9) computer technology, 10) transportation, and 11) space.

At the present time, numbers 4 , 5, and 11 are not included in technology education as described in this document, but all of the other items are. Educators and others who use the term "technology" to describe computers and electronic learning hardware would be well advised to read this highly regarded and frequently quoted study report.

Regarding the relationship of technology education to other disciplines such as science, the report states:

> *Technology is also a technical process. It is different from science, whose role is understanding. Technology's role is doing, making, and implementing things. The principles of science, whether discovered or not, underlie technology. The results and actions of technology are subject to the laws of nature, even though technology has often preceded or even spawned the discovery of the science on which it is based. Most modern technology, particularly that embodied in systems, is fabricated through the technical designs of engineering, and it enters society according to the perceived needs of the socioeconomic system. Therefore, young adults should know some of the underlying basic science, mathematics, and engineering concepts, and their relationship to technology. They should be familiar with the use of the basic tools involved, from applied mathematics to design, computers, and hardware. They should understand that technology does not stand apart from the society it serves.*

Introduction and goals

Society's move into the information age has made technology education/industrial technology more important than ever before – responding to the need to communicate faster and more effectively, and to understand and use computers and the numerous other technologies that impact our lives.

Technology education/industrial technology includes the areas of communication, energy and power, production, and transportation. It is concerned with technology and its evolution, use and significance; with industry, and its organization, personnel, systems, techniques, resources, and products; and finally, the social/multicultural impact of both technology and industry.

Technology education/industrial technology involves students in many non–traditional classroom activities such as problem solving and research and development—all with a heavy emphasis on "learning by doing." It provides an exploration of and familiarization with the technical world, the general technical knowledge required in many occupations, and introduces students to a broad range of careers requiring technical knowledge and skill.

As education is organized and delivered today, technology education/industrial technology encompasses learning which may begin in the elementary school with a single unit or lesson, continue as part of a required junior high or middle program, progress still further with a semester–length course at grade ten, and culminate at the twelfth–grade level with an intensive, occupationally specific program. The move to outcome–based education, new graduation standards, and personalized learning plans may make significant changes in that this field of study has the potential for integration with many school subjects, and can provide application experiences which will increase the relevance of many school experiences.

At the introductory level, students participate in broad, exploratory experiences designed to familiarize them with communication, energy, and power utilization, production, and transportation. Students, working in a "hands–on" laboratory environment, are introduced to broad concepts of how technical communication is accomplished, how goods are produced and transported, and how energy and power relate to industry and society.

Beyond the introductory level, students have an opportunity to further explore their interests in courses of greater length and intensity. For example, most high schools offer semester–length electives in a variety of technical subjects.

At the eleventh– and twelfth–grade levels, students have an opportunity to concentrate on an occupational area such as graphic communication, construction, drafting, electronics, machine shop, or auto mechanics. These programs have the multiple objectives of 1) occupational exploration, 2) preparation for postsecondary training in that area, and 3) job preparation. They offer students an opportunity to study and learn with an instructor who has worked extensively in the specific occupational area taught, and provide instruction and shop or laboratory activities which provide more than an introductory or survey experience.

The Minnesota Plan for Industrial Technology Education

The goal of technology education/industrial technology is to develop students who are technologically literate. This means students and young adults who understand and appreciate the highly technical world in which they live. This means using process skills and providing experiences in classroom activities that assist in developing self–forming people who are autonomous and in control of their lives. Technology education/industrial technology emphasizes both knowing and doing. It applies mathematics, science, and communication concepts to "real world" problems citizens face in their daily lives. It provides relevance and application which integrate learning which may previously have been fragmented, isolated, or disconnected from any experience or environment the student may have encountered. It requires higher order skills such as analysis and synthesis to solve problems, constructing usable devices, and understanding industrial–technical systems.

Technology education/industrial technology also meets the alternative learning styles of some students. Rather than dealing almost entirely in abstraction, as some disciplines do, concrete learning experiences based on learning by doing characterize this field of study.

The goals of Technology Education/Industrial Technology as stated in the *Minnesota Plan for Industrial Technology Education* are to:

- prepare students to work with technical systems within the areas of communication, production, transportation, and energy–power use

- assist students in assessing and preparing for current and emerging occupations
- enhance student mastery of the basics through application of mathematics, science, social studies, communication, and computer literacy
- develop student awareness and skill through the safe use of tools, materials, and equipment
- provide students with a foundation in entrepreneurship, economics, and business relationships
- assist students in becoming independent learners and creative problem solvers who possess self–confidence and lifelong learning attitudes
- establish beliefs and values based upon the impact of industry and technology and how it alters environments
- explore and develop human potential related to responsible roles in a technological society
- enhance technological literacy.

Chapter 3

Technology Education/ Industrial Technology

Model Learner Outcomes

Chapter 3

This chapter lists suggested outcomes to be achieved by students in technology education/industrial technology. These learner outcomes are most important to be taught, and are representative of these experiences students most need.

Chapter 3A includes the outcomes which are intended primarily for grades 6–10. Included are the four areas of communication, energy and power, production, and transportation, which provide a broad sample of technologies related to human endeavor in these areas. Student offerings in grades 6–10 should provide students a balance of learner outcomes, i.e., approximately equal amounts of time should be devoted to each of the four areas. Learner outcomes selected should also reflect the "learning by doing methodology of technology education. Quality technology education programs are characterized by frequent use of terms such as "use, perform, build, test, experiment, and solve."

Chapter 3B includes narrow, more specifc outcomes for eleven areas of specialization commonly found in technology education/industrial technology, including architectural drafting, automotive technician, carpentry occupations and finishing trades, construction, electronics, graphic communication, machining, mechanical drafting, small engine repair, technology cooperative programs, and welding. These outcomes might be used in a variety of ways. They might, for example, form the core of a semester–length high school elective. Or, outcomes from two areas such as mechanical drafting and architectural drafting might be combined to offer a general introduction to drafting.

Outcomes in 3B might also be used to form the basis of an occupational program offered at grades 11 and 12 which qualifies for vocational funding. Outcomes are correlated with teacher licensure requirements and minimum program offering criteria.

These eleven areas are defined as follows:

Architectural Drafting Occupations. Learning experiences concerned with all business, planning, and preparation necessary to begin erection of a construction project.

Automotive Technician Occupations. Learning experiences concerned with the maintenance and repair of automobiles.

Carpentry Occupations and Finishing Trades. Learning experiences concerned with rough carpentry and residential interior finishing.

Construction Occupations. Learning experiences concerned with all phases of residential construction.

Electronics Occupations. Learning experiences concerned with the design, construction, maintenance, troubleshooting, and repair of electronic devices.

Graphic Communication Occupations. Learning experiences concerned with the design, preparation, printing, and assembly of printed material.

Machining Occupations. Learning experiences concerned with metal properties, machining, and heat treating.

Mechanical Drafting Occupations. Learning experiences concerned with the knowledge and skills necessary to convey ideas, shapes, and specifications necessary to manufacture or reproduce mechanical items.

Small Engine Repair Occupations. Learning experiences concerned with maintaining and repairing small engines.

Technology Cooperative Programs. Learning experiences which expand knowledge and skill gained in technology areas, and with competencies attained through school–employer partnerships that will help learners succeed in employment.

Welding Occupations. Learning experiences concerned with the fusion or separation of metals for fabrication or repair purposes.

Students electing a high school or vocational center course in the industrial technology areas described in this document are juniors or seniors in high school who have identified a tentative interest in this occupational area. This interest may have been developed in a technology education/industrial arts offering at a lower grade level, or may have been sparked by some other method, or in an earlier experience when, for example, a math concept was integrated with an application such as drafting, building a rafter, or machining a part; or a science concept such as pressure was integrated with a technical application such as hydraulics or pneumatics.

And what will students get when they take this course? The class will have multiple objectives, which students themselves will determine through the use of what they learn. Some students will use this as the first phase of training for employment in this occupation, moving later to more specialized or indepth training in a postsecondary school. Other students will secure entry–level employment as a result of this educational experience. Still other students will use this class to determine if they really like this occupational field, and some will legitimately determine that this is not quite what they had in mind. Finally, others may develop hobby, leisure, or other avocational uses from what they learned.

Knowledge imparted to students must be specific enough to provide some immediate application and assistance in solving a variety of classroom problems. Learning by doing is of paramount importance; applications for every major concept taught must be provided. Program learnings must also be generalizable or transferable to a variety of like situations. It must also be futuristic so that students can move into the occupations of tomorrow which will replace many of today's jobs.

Technology education/industrial technology learner outcomes listed in this document are consistent with and support the State Board of Education Curriculum Rule 3500.1075, or program level learner outcomes.

The program level outcomes are as follows:

1. analyze applications of a variety of technologies to trade and industry
2. apply the knowledge within one of the current or emerging occupations in trade and industry
3. understand the interrelationships among communication, energy and power use, production, and transportation technologies
4. understand industry as an organized structure that uses resources to produce goods, services, and information
5. apply the concepts of science, mathematics, and communications to solve technological problems
6. use industrial tools, materials, and equipment safely and effectively
7. develop career plans through participation in a variety of industrial technology learning activities
8. assess current and emerging industrial/technical occupations as they relate to business and entrepreneurial opportunities; and
9. assess the impact of industry and technology on the environment.

Each learner outcome corresponds to one or more of the State Board of Education Learner Goals identified in Chapter 1. The outcomes are also referenced to the cognitive (knowing, applying, and integrating), psychomotor, and affective development domains. Outcomes that focus on multicultural, gender fair, and international/global concept development are coded to indicate this emphasis. In future versions of this document, the learner outcomes will be keyed to items for industrial technology in the Minnesota Department of Education Test Itembank.

Model Learner Outcomes for Technology Education/ Industrial Technology

Chapter 3A

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
Communication			
	Students will be able to:		
A.1, 2, 3, 4, B.10 K.4, 5, I.8, M.4	1. identify ten communication careers	Knowing, Applying	
A.1, 2, 3, 4, 6 B.8	2. recognize the relationship of communication concepts to energy and power use, production, and transportation	Integrating	
L.3	3. practice sound safety practices in conducting communication activities	Knowing, Applying Psychomotor, Affective	
D.2, 3	4. analyze communication impacts on the environment	Integrating, International/Global	
A, C, F.4, M.1	5. develop problem-solving skills and creative thinking abilities through solving communication problems	Knowing, Applying Psychomotor Affective, Integrating	
A, C, M.1	6. identify graphic and electronic communication mediums and distinguish between major communication subsystems	Knowing, Integrating	
A	7. describe and apply the elements of the communication process model, including transmitter, channel, receiver, feedback, and interference	Knowing, Applying Psychomotor Integrating	
A, B.8, 10, K	8. describe technological developments in communication.	Knowing	
A.7, C, M.1	9. develop research, writing, and organization skills by examining selected areas of communication technology	Applying, Integrating	
A.6, 7, C	10. differentiate between graphic and electronic communication mediums	Knowing, Integrating	

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
B.8	11. identify and describe the roles of communication in industry, e.g., to inform, persuade, educate, promote equity, and entertain	Knowing, Applying Integrating Multicultural Gender Fair	
B, C, H, K	12. identify communication impacts on society and the environment	Knowing, Affective Integrating International/Global	
A.1, 2, 3, 4 B.3, 4, 5, 6, 8 C, F.5, G.3, M.1	13. identify problems and alternate solutions to negative impacts of communication concerning pollution, finite supplies, cultural values, and stereotypes	Knowing, Applying Affective, Integrating Multicultural Gender Fair International/Global	
A.2, 4, 6, M.6	14. identify drafting tools, equipment and materials, and demonstrate their proper use	Knowing, Applying Psychomotor	
A.2, 4, 6, M.1	15. demonstrate knowledge of drafting processes and techniques, including lettering, types of lines, types of drawings, and scaling	Knowing, Applying Psychomotor	
A.7, C., M.5	16. use design concepts to develop problem-solving and creative thinking abilities through product design and innovation	Knowing, Applying Psychomotor Affective, Integrating	
A.2, 4, B.2	17. describe applications of design and drafting techniques in industry, business, government, or education	Knowing	
A.6, M.1	18. use new applications of drafting and design in communication, including computer-generated graphics, CAD/CAM, etc.	Applying, Psychomotor	
A.2, 4, 6, B.10	19. identify present and future impacts that cable, satellite communication, and interactive data have on diverse cultures	Knowing, Affective Integrating International/Global	
A.1, B.8, 10	20. identify developments from the past and future which have significantly affected the growth of television and radio use	Knowing, Affective Integrating	
A.6, C.3, F.4 F.17, M.4	21. explain the fundamental characteristics, roles, structure, and organization of radio and television production	Knowing, Affective Integrating	
A.6, F.4, I.7, 8 L.1, M.1, 5	22. perform broadcasting production skills	Knowing Psychomotor, Applying	
A.5, 6, B	23. identify the basic systems and functions of radio and television	Knowing, Integrating	

STATE BOARD LEARNER GOALS		LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
A, B, D.2, K	24.	use the equipment and materials to transmit, receive, and store messages via computers	Knowing, Applying Psychomotor Integrating	
A, B.1, C, K	25.	recognize new and evolving computer components and capabilities	Knowing, Applying Integrating	
A, C, E, M.1	26.	identify capabilities and limitations of computers	Knowing, Integrating	
A, C	27.	identify components of a typical computer; input, memory, output, and central processing unit	Knowing	
A, C, M.1	28.	describe how computers interface with other machines to control processes	Knowing, Integrating	
A, B.1, 6, 8, 11 C, D.2, E, F.5 J.3, 7, K	29.	assess the effects that computers have made and will make on society, human needs, gender equity, environment, ethics, and national and global cultural values	Affective, Integrating Multicultural Gender Fair International/Global	
A, B.1, C.1, 3	30.	contrast different types of photographic materials and equipment	Knowing, Integrating	
A	31.	explain the principles of photography	Knowing, Integrating	
A, B.1, 10, 12 C.1, L.1, 7, 8	32.	demonstrate effective means of conveying a message using a photographic medium	Knowing, Applying Psychomotor Integrating	
A.3, 6, B.1, 8 C, M.1	33.	recognize new applications of photography in solving technological problems	Knowing, Affective Integrating	
A.1, 2, 4, B.9 C.3	34.	assess the importance of photography as a communication medium	Knowing, Applying Integrating	
A, B.1, 2, C.1 I.7, 8, M.5	35.	use equipment to convey a graphic message	Knowing, Applying Psychomotor	
A, B.10	36.	compare the major types of printing processes	Knowing, Applying Integrating	
A, I.7, 8, M.5	37.	convey a message through a graphic medium	Knowing, Applying Psychomotor	
A, B.10, I.7	38.	assess new processes and techniques used in industry to prepare, process, produce, and distribute graphic copy	Knowing, Integrating	

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
A, B.8, 10 C.1, 3	39. describe how computers, photography, broadcasting, design, drafting, and telecommunication are used in graphic arts technology	Knowing, Applying International/Global	
A, B.8	40. give examples of modern communication systems and devices	Knowing	
A, B.8, 11, C.1	41. define high technology terms associated with telecommunications-like satellites, lasers, holography, and magnetic bubbles	Knowing	
A.1, 2, 3, 4, B.8 C, M.2	42. identify and evaluate innovative developments in communication technology	Knowing, Affective	
A.6, B.8, 10, C I.7, 8, M.1	43. experiment with processes, equipment, and materials to develop insight into new and advancing technologies	Psychomotor Affective, Integrating	
A.6, B.8, F, M.1	44. solve hypothetical industrial communication problems through problem solving, creative thinking, and decision-making processes.	Knowing, Affective Integrating International/Global	

Energy and Power Use

Students will be able to:

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
A.1, 2, 3, 4 B.10, K.4, 5, L.8	1. identify ten energy and power careers	Knowing, Applying	
A.1, 2, 3, 4, 6 B.8	2. recognize the relationship of energy and power concepts to communication, production, and transportation	Integrating	
L	3. practice sound safety practices in conducting energy and power activities and as a consumer	Knowing, Applying Psychomotor Affective	
D.2, 3	4. analyze energy and power impacts on the physical environment	Integrating International/Global	
A, C, F.4	5. develop problem-solving skills and creative thinking abilities through solving energy and power problems	Knowing, Applying Psychomotor Affective, Integrating	
A.5, 6, M.1	6. use instruments to measure and interpret data in the area of energy and power use	Applying, Integrating	
A.6, B.8, C.3 L.7	7. illustrate how energy and power can be transmitted from one point to another	Knowing, Applying Psychomotor	

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
A.1, 2, 3, 4	8. define energy and power terms	Knowing	
A, B.4, D.2, 3 H.1, 2, 3	9. analyze energy sources and relate them to energy shortages, conservation, and population projections	Integrating International/Global	
D.2, H.1	10. examine how energy usage has affected our lives throughout history	Integrating International/Global	
A.6, I.6, M.1	11. store energy and power using a variety of methods	Applying Psychomotor	
A.5, 6, I.7, M.1	12. construct and operate a solar collector	Applying Psychomotor	
A, B.6, 8, D.2 F.2, H.2, K.1	13. identify technical and cultural factors affecting progress in solar research	Integrating International/Global	
A.1, 2, 3, 4 B.8, D.2, 4	14. relate geographic location and seasonal effects to solar energy usage	Integrating International/Global	
A.3, 4, 6, 7 B.6, 8, C, D.2	15. compare sensing and controlling devices used on solar collectors	Knowing, Applying Integrating	
A, B, C, D.2	16. discuss the impact of tax incentives on the development of alternative energy sources	Knowing, Integrating International/Global	
A.1, 5, B.6, C D.2, F.4, M.1	17. test active and passive solar systems	Applying Psychomotor Integrating	
A.3, 4, 6, C I.7, M.5	18. build and test a propeller	Knowing, Applying Psychomotor Integrating	
A.3, 4, 6, B D.2, M.1	19. use mathematical formulas to calculate electrical, fluid, mechanical, and radiant power values	Knowing, Applying Integrating	
A, B, C, D.2 D.3, 4	20. analyze environmental considerations associated with alternative energy and power usage	Knowing, Applying Affective, Integrating International/Global	
A.1, 3, 5, 6 C, F.4, M.1	21. experiment with gears to demonstrate speed reduction, torque, and power transmission	Knowing, Applying Psychomotor Integrating	
A, C.1	22. distinguish between devices used to convert energy from one form to another	Knowing, Integrating	
A, C.1, 3	23. identify common building heat loss factors and solutions	Knowing, Applying Integrating	

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
A.5, 6, C.1, 3 M.1	24. apply computer technology by processing and interpreting energy data	Knowing, Applying Psychomotor Integrating	
A.6, B.6, C.3 L.7	25. identify areas in residences where energy can be conserved	Knowing, Applying Integrating	
A.1, 2, 3, 4, 5 B.6, 8, 11 C.1, D.2, K.3	26. compare energy resources and future energy needs	Knowing, Affective Integrating International/Global	
A.1, 5, 6	27. test conductors and insulators of electricity	Knowing, Applying Psychomotor Integrating	
A.6, C.1, 3, M.1	28. operate advantage-gaining devices used in energy and power areas, e.g., transformers, gear sets, and venturis	Knowing, Applying Psychomotor	
A.1, 2, 4	29. identify the parts and systems of a modern electrical generating plant	Knowing	
A.1, 2, 3, 4, 6 C.3, F.4, I.7, M.1	30. produces electricity using solar energy, wind, or moving water	Knowing, Applying Psychomotor	
A, B.1, D.4.	31. name the three major fossil fuels and the locations of large world deposits	Knowing, Integrating International/Global	
A, B	32. describe the methods by which energy resources are extracted, refined, and transported	Knowing, Applying International/Global	
A, B, C, D.1, 2 F.4	33. make efficiency comparisons of home heating systems which employ fuel oil, natural gas, wood, and electricity	Knowing, Applying Affective, Integrating	
A, B.1, 8, 9, 10 C.4, D.1, 2, F J.3, 7, K.1	34. project future fossil fuel supplies and their impact on diverse cultural groups and the environment	Knowing, Applying Affective, Integrating Multicultural Gender Fair International/Global	
A, B, C.4, D.4 F.3, 4, H.1, 2 K.1, 4	35. analyze geographic regions and determine which method of producing electricity would be best suited for the area	Knowing, Applying Affective, Integrating International/Global	
A, B.1, 8, 9, 10 D.2, 3	36. describe direct and indirect benefits of electric power generation	Knowing, Applying Affective, Integrating International/Global	

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
A, B.8, D.2, 3	37. identify benefits and problems associated with using the wind to generate electricity	Knowing, Applying Affective, Integrating International/Global	
A.5, 6, B.1, 8 B.9, 10, C.3, 4 D.2, M.1	38. test the ability of various materials to absorb, reflect, and/or conduct heat energy	Knowing, Applying Psychomotor Affective, Integrating International/Global	
A, B.1, F.5 J.4, 5	39. define the terms "renewable" and "non-renewable" energy sources and identify several examples of each	Knowing, Applying	
A.7, B.1, C	40. analyze the projected growth rate and demand for non-renewable energy resources	Knowing, Integrating International/Global	
A, B.1, D.2 F.5, J.4, 6	41. define energy conservation and relate it to future energy demand and its social, cultural, and political implications	Knowing Multicultural Gender Fair International/Global	
A, B.1, D.2 F.5, J.4, 6	42. apply energy conservation practices to daily activities	Knowing, Applying Psychomotor	
A.6, B.1	43. draw a block diagram of a basic nuclear reactor	Knowing, Applying Psychomotor	
A.6, B.1	44. draw an atom and identify each part by name	Knowing, Applying Psychomotor	
A, C	45. relate atomic structure to properties of insulation and conductivity	Knowing, Applying	
A, B.1	46. identify each of the radioactive particles and/or rays which are given off during a nuclear reaction	Knowing	
A.1, 2, 3, 4, B.1	47. describe the effects on humans of various doses of radioactivity	Knowing, Applying Integrating International/Global	
A, B.1	48. explain how energy is released during a nuclear chain reaction	Knowing, Integrating	
A.2, 4, B.1 C, F.5	49. debate the safety of nuclear energy.	Knowing, Applying Affective, Integrating International/Global	

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK

Production

Students will be able to:

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
A.1, 2, 3, 4 B.10, K.4, 5, L.8	1. identify ten construction and manufacturing careers	Knowing, Applying	
A.1, 2, 3, 4, 6 B.8	2. recognize the relationship of production concepts to communication, energy and power use, and transportation	Integrating	
L	3. practice sound safety practices in conducting production activities	Knowing, Applying Psychomotor Affective	
D.2, 3, 4	4. analyze production impacts on the environment	Integrating International/Global	
A, C, F.4, M.1	5. develop problem-solving skills and creative thinking abilities through solving production problems	Knowing, Applying Psychomotor Affective, Integrating	
A.2, 4, C	6. explain a system using the input-process-output-impact model	Knowing, Integrating	
A.2, 4	7. describe the four industrial technologies--e.g., communication, energy and power, production, and transportation	Knowing	
A.1, 3, B, C M.4	8. develop a rationale for learning about production, e.g., manufacturing and construction	Affective, Integrating	
A.2, 4, B.1, H	9. describe major historical developments including their social/cultural implications in manufacturing and/or construction	Multicultural Gender Fair International/Global	
A.3, C	10. analyze differences between manufacturing and construction systems	Integrating	
A.4, C	11. explain the advantages and disadvantages of custom versus mass production	Knowing, Integrating	
F.4, L.7, J.3 M.5	12. practice basic concepts of quality control	Applying Psychomotor	
A.1, 3, B.1, M.4	13. become aware of current production trends and activities	Knowing	
A, B.6, 8, 10, 11 C, D	14. identify and describe material, human, and capital resources necessary for materials processing	Knowing, Applying Integrating International/Global	

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
A, C.3, I.7, 8 M.5	15. use different types of industrial materials, e.g., ceramics, composites, wood, and metal	Knowing, Applying Psychomotor	
A, C.3, M.1	16. develop an awareness of basic forming processes by describing and using casting, molding, compressing, stretching, and conditioning processes	Knowing, Applying Psychomotor	
A, C.3, I.7, 8 M.5	17. perform the following industrial operations: separating, turning, drilling, milling, sawing, shaping, planning, grinding, sanding, and shearing	Knowing, Applying Psychomotor	
A, C.3, L.7, 8 M.5	18. perform the following combining operations: mixing, coating, bonding, and mechanical fastening	Knowing, Applying Psychomotor	
A, I.7, 8, M.1, 5	19. use basic tools and machines to process materials	Knowing, Applying Psychomotor	
A, B.6, 8, 9, 11 C, D.3, E, J, K	20. discuss the impacts of new technology on the efficiency, cost, and speed of manufacturing and construction, and their social, national, and international political implications	Knowing, Affective Integrating Multicultural Gender Fair International/Global	
A, B.3, C, J, K M.3	21. perform management functions, including planning, organizing, directing, and controlling	Knowing, Applying Psychomotor Integrating	
A, B.1, 9, C, J K	22. explain the steps used in managing, e.g., gathering information, considering alternatives, and formulating goals	Knowing, Applying	
A, C	23. describe the organization process, e.g., identifying tasks, assessing needs, and delegating authority	Knowing, Integrating	
A, I.8	24. build an organizational chart	Knowing, Applying	
A, D.2, J, M.2	25. compare and contrast the types of multicultural, gender fair, human resources, e.g., management, technical, and production-type human resources	Knowing, Affective Integrating Multicultural Gender Fair	
A, B.10, 12, 13 I.7, 8, M.6	26. fill out a job application and complete an interview	Knowing, Applying Psychomotor Multicultural Gender Fair	
A. I.7, 8	27. keep records such as inventory, costs, hours worked, etc.	Knowing, Applying Psychomotor	

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
A.7, B.1, J	28. develop and use time and motion study charts	Knowing, Applying Psychomotor Integrating	
A	29. generate working capital	Knowing, Applying	
A., B.1, 3, 8, 10 B.12, 13, C, E F, G, J, K, M.2	30. become aware of impacts and effects on people and goods of strikes, layoffs, company/business politics, labor contracts, affirmative action, quality of life, and buying power	Knowing, Affective Integrating Multicultural Gender Fair International/Global	
A.1, 2, 3, 4, B.1 B.8, 9, 10, 11 B.12, C, I.2	31. explain why research and development is an important phase of production	Knowing, Integrating	
A, B.1, 8, 9, 10 B.11, C, E.1, 3 F. 4, 5, G.1, 3 I.1, 2, 7, 8, J.2 J.3, 7, K.1, M.1	32. perform the steps involved in research and development	Knowing, Applying Psychomotor Affective, Integrating	
A, B.4, 8, 11, C E.1, 2, F.4, K.1	33. use market surveys, sampling techniques, and research to identify consumer needs of diverse ethical and cultural groups	Knowing, Applying Affective, Integrating Multicultural Gender Fair	
A, B.1, 9, C, F.4 F.5, I.1, 2, 6 J.2, 7, K.1, 3	34. propose designs, ideas, alternatives, and solutions through presentations	Knowing, Applying Affective, Integrating	
A.5, 6, B.8, C F.4, I.7, M.5	35. field-test prototypes to determine their use and quality	Knowing, Applying Psychomotor Affective, Integrating	
A, B.8, 9, 10, 12 C, F.4, I.1, 2, 7 I.8, J.2, M.1, 5	36. develop tooling for a given product in a manufacturing or construction operation	Knowing, Applying Psychomotor Integrating	
A.2, 3, 4, B.2, 4 J.4	37. describe a manufacturer's responsibility for product liability	Knowing, Applying Affective, Integrating	
A.1, 2, 3, 4, C D.3	38. differentiate between the types of resources used in manufacturing and construction	Knowing, Integrating	
A.6, C	39. engage in preliminary production activities such as plant layout, site preparation, bidding a project, and making jigs and fixtures	Applying Psychomotor	
A, F.4, C	40. develop and use industrial charts	Applying Psychomotor Integrating	

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
A.4, 3, 6, B.8	41. identify and use materials handling systems	Knowing, Psychomotor Integrating	
A, B.1, 8, 10, 11 B.12, C, D.3 F.4, G.3, I.1, 2 I.7, 8, J.2, 3, M.5	42. simulate production technology through planned and controlled manufacturing and construction activities	Applying Psychomotor Integrating	
A.1, 3, 5, 6, B.8 B.9, 12, I.7, 8 K.1, 4, M.1	43. use CAD/CAM and robotic applications to enhance production systems	Applying Psychomotor Integrating	
B.11, C.1, 2, 3	44. explain the difference in marketing manufactured goods and constructed products	Knowing, Applying Integrating	
B.11, C.1, 2, 3	45. discuss uses of marketing for informing, educating, and persuading consumers of diverse backgrounds	Knowing, Applying Affective, Integrating Multicultural Gender Fair	
B.11, C.1, 2, 3	46. define the role of advertising in creating needs among diverse groups	Knowing, Applying Affective, Integrating Multicultural Gender Fair	
A.6, C.3, F.4 I.7, 8	47. identify and use various marketing mediums available for product promotion	Knowing, Applying Psychomotor Integrating	
B, C, H, K	48. become aware of the impact of packaging on sales and the environment, and the social, cultural, and political implications	Knowing, Affective Integrating Multicultural Gender Fair International/Global	
A, B.8, 11, M.4	49. identify and describe the tools, materials, human, and capital resources used for servicing products	Knowing, Integrating	
A.6, B.6, 7, 8 B.11, C	50. determine the effects of extended use on products.	Knowing, Applying Integrating International/Global	
A, B.1, 8, 10, 11 C, I.7, 8	51. use repairing, altering, installing, and maintaining operations to demonstrate the servicing phase of production systems	Knowing, Applying Psychomotor Integrating	
B, C, H, K	52. discuss environmental societal impacts that servicing creates	Knowing, Integrating International/Global	
B.10, I.7, 8 K.3, 4	53. understand the differences between new construction, remodeling, and retrofitting.	Knowing, Integrating	

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK

Transportation

Students will be able to:

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
A.1, 2, 3, 4, B.10 K.4, 5, I.8	1. identify ten different transportation careers	Knowing, Applying Integrating	
A.1, 3, C.1, 3	2. recognize ways transportation systems are used in the areas of energy and power use, communication, and production	Knowing, Integrating	
A.1, 3, 4, L.1	3. identify safety procedures which have developed due to our increased use of transportation	Knowing	
A.1, 2, 3, B.1, 4 B.8, 11, D.2, 3, 4	4. analyze the impact transportation has had and will have on the environment and on diverse cultures in society	Integrating International/Global	
A, C, F.4, M.1	5. conduct research and development activities in areas of aerodynamics, vehicle design, and propulsion	Knowing, Applying Psychomotor Affective, Integrating	
A, B.1, 4, 8, 9 C, F.4, I.2, 7, J.2	6. design a transportation vehicle of the future	Applying, Psychomotor Integrating	
A.1, 2, 3, 4 B.8, 11, C	7. identify unique problems in transporting people and goods and list possible solutions	Integrating International/Global	
A, B.8, 12, C I.7	8. recognize the importance of design features in transportation systems	Knowing, Affective Integrating	
A, B, C, J.6, K.4	9. predict the role that space shuttles and other space vehicles will have in transporting people and goods	Integrating International/Global	
A, B, C, H.3 L.7, 8	10. give examples of developments in transportation among diverse cultures throughout history	Knowing, Applying International/Global	
A.1, 2, 3, 4 B.1, 8, C, D.2 D.3, H	11. evaluate the contributions that space transportation has made and will make in the technologies of production, communication, and energy and power use	Integrating International/Global	
A.6, B.1, C M.1, 5	12. produce various devices needed to transport goods and people within the four transportation environments	Applying Psychomotor	
A, B.1, C	13. compare modes of transportation	Knowing, Applying Integrating	

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
A, B.1	14. examine how propulsion, control, and structural systems operate in the four transportation environments	Integrating	
A.2, B, C D.2, 3	15. evaluate the layout and location of an airport	Applying, Integrating	
A.1, 3, 4, B.1	16. list factors involved in safe air travel	Knowing	
A.2, 4, C.1, 3	17. compare the advantages, disadvantages, and applications of vehicles and devices in the transportation of diverse people and goods	Knowing, Applying Integrating	
A.1, 2, 3, 4, 6 B.8, C.1, 3, 4	18. trace the development of transportation methods and the effect they had on travel time.	Knowing, Integrating	
A.1, 2, 3, 4, B.8 C.1, 3, 4	19. demonstrate an understanding of the foundational developments which led to space transportation	Knowing, Integrating International/Global	
A, B.7, 8, C.1 C.3, 4	20. identify the various passenger and non-passenger-carrying spacecrafts and their uses throughout the history of space flight	Knowing, Integrating International/Global	
B.8, C	21. recognize the production aspects of support systems such as highways, canals, and bridges	Knowing	
B, C, H, K	22. identify various modes of vehicular and stationary transportation and their contributions to society	Knowing, Applying Integrating International/Global	
A.7	23. analyze technical data and apply it to transportation problems	Knowing, Applying Integrating	
A.3, 5, 6, B.8 C, I.7, 8, M.5	24. construct a transportation vehicle with a structural, propulsion, and control system	Knowing, Applying Psychomotor	
A.1, 3, 5, 6, C	25. use navigational charts and maps to locate positions and barriers to traffic	Knowing, Applying Psychomotor	
M.1, 5	26. construct a scale model of an airport, freeway interchange, or bridge	Knowing, Applying Psychomotor Integrating	
M.1	27. perform aerodynamic tests such as lift and drag in a wind tunnel	Knowing, Applying Psychomotor Integrating	

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
General Outcomes			
	Students will be able to:		
A, B.2, 3, 5, D, E F, G, I, J, L.5, M	1. demonstrate leadership, human relations skills, and a positive self-concept through participation in Vocational Industrial Clubs of America (VICA), Technology Student Association (TSA), or other appropriate student organizations	Applying International/Global Multicultural Gender Fair	
B.3, D.1, 2, 3 F.2, 3	2. demonstrate respect for clients, customers, and co-workers of diverse cultures and both genders, including persons with disabilities	Multicultural Gender Fair Disability Sensitive	
B.4, 5, 6, 7, 10	3. recognize that technology itself is neutral, but that the use to which it is put may provide positive or negative results or benefits.	Knowing, Integrating	
Gifted/Talented Outcomes			
	Students will be able to:		
C.1, 2, 3, D.2	1. analyze the interrelationships between the technical areas of communication, energy and power, production, and transportation	Knowing, Applying Integrating	
C.1, 2, 3	2. use problem solving as a major focus of learning; present alternative solutions to real-world technical problems	Integrating	
A, C, M.1	3. identify global problems or concerns which may be attributed or related to the use or misuse of technology	Knowing	
A.6, C	4. invent novel ways to use technology	Applying, Integrating	
A, B.8, C	5. design a package for a product which has been produced in a technology class	Applying, Integrating	
A.5, 6, C, M.1	6. interface a computer with a mechanical device to provide automatic operation or control	Applying, Integrating	
A, B.8, C	7. design a mass transit system for a specific community	Applying Integrating	
C, D.2, M.1	8. recognize the interrelatedness of systems in a broad context of study--technology, science, mathematics, human behavior, e.g., how has technology affected human behavior?	Knowing, Integrating	
A.7, B.5, 6, 7 C, M.1	9. observe a technical process or product; collect data regarding the costs, methods of production, possible improvements, and environmental impact. Prepare a report which describes these findings and makes recommendations for improvement.	Knowing, Integrating	

Model Learner Outcomes for Technology Education/ Industrial Technology
Chapter 3B

Architectural Drafting Occupations

Drafting Occupations. Learning experiences concerned with the knowledge and skills necessary to convey ideas, shapes, and specifications necessary to produce plans or drawings which will be used to construct a building.

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
	1. Equipment and Materials		
	Students will be able to:		
A.6, 7, C.1	a) select appropriate drawing tools, e.g., lead holders, lead, technical pens, compasses, and erasers	Applying	
A.6, 7, C.3	b) select appropriate drawing medium, e.g., paper, vellum, mylar, and sepia	Applying	
A.6, C.1, M.1	c) operate drafting machines, e.g., track, elbow, and parallel bar	Applying	
A.6	d) operate reproduction equipment.	Applying	
	2. References and Standards		
A.1, 5, 7, C.1, M.1	a) follow appropriate drafting standards by consulting references such as *Architectural Graphic Standards* (student edition), *Timesaver Standards, Sweets,* and local building code books	Applying	
A.6, C.1	b) use appropriate line weights and types to complete drawings	Applying	
A.6, M.1, 5	c) letter quickly and legibly according to industry standards	Applying	
A.2, 5, C.2	d) use standard drawing symbols to designate objects, details, and appropriate information	Applying	
A.5, C.1	e) determine appropriate scale and sheet layout	Applying	
C.1, 2	f) read and interpret blueprints.	Applying, Integrating	

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
	3. Using Mathematical Principles and Geometric Constructions		
A.5	a) apply adding, subtracting, multiplying, and dividing of whole numbers, fractions, decimals, and percentages to solve problems	Applying	
A.5	b) solve mathematical problems such as area, volume, weight, and calculation of angles	Applying	
A.5	c) convert between fractions and decimals, and between English and metric units	Applying	
A.5, 6, C.1	d) use geometric construction procedures to divide lines, arcs, and circles	Applying	
A.5, 6, C.1	e) use geometric construction procedures to construct parallel, perpendicular, and tangent lines	Applying	
A.5, 6, C.1	f) use geometric construction procedures to construct arcs, circles, curves, ellipses, and polygons.	Applying	
	4. Sketches, Pictorial Drawings, Renderings, and Technical Illustrations		
A.2, 5, C.1 M.1 M.5	a) produce orthographic and pictorial sketches	Applying	
A.6, 8, B.8, C.1	b) produce pictorial drawings, e.g., axiometric, oblique, perspective, and isometric	Applying	
A.6, 8, B.8	c) produce renderings or technical illustrations using accepted design principles.	Applying	
	5. Dimensions and Tolerances		
C.1	a) read common drafting scales, e.g., architectural, engineering, and metric	Knowing	
A.5, C.1	b) use fractional, decimal, and metric units to show sizes, dimensions, and tolerances as appropriate	Applying Integrating	
C.1, M.1	c) use notes, flags, and balloons to provide necessary information or detail.	Applying	

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
	6. Computers and Related Equipment		
A.6	a) operate input devices such as graphic tablet, mouse, and keyboard	Applying	
A.6	b) operate output devices such as plotter, printer, and CRT	Applying	
A.7, C.2	c) compare computer equipment capabilities, e.g., speed, memory	Integrating	
A.1, 7, C.3	d) identify software characteristics such as speed, cost, capability, compatibility, ease of learning, flexibility, user friendliness, and expandability	Integrating	
A.6, C.1, 2, 3 M.1, 5	e) construct a CAD drawing of an object	Applying	
A.6, C.1, 2, 3 M.1, 5	f) use computers and appropriate software to estimate projects, produce material lists, complete engineering computations, provide simulations, solve rendering and shading problems, and word processing.	Applying	
	7. Design, Problem Solving, and Model Construction		
B.3, D.1, 2, 3	a) work individually or in groups to solve problems and produce design solutions	Knowing Applying Affective	
A.2, 4, 8, B.8	b) present design solutions orally, in writing, or in graphic form as appropriate	Applying	
A.6, C.1, 2, 3 M. 1, 5	c) construct models or a design layout.	Applying	
	8. Construction Drawings		
A.1, 3, 7, C.3	a) identify building materials commonly used in construction	Knowing	
A.2, 5, C.1, M.1 M.5	b) produce preliminary design drawings for a residential or light commercial building	Applying	
A.6, 8, B.8, C.1 M.1, 5	c) assemble a simple architectural model to study proposed project	Applying	
A.1, 2, 4, 5, 7 C.2	d) use plot plans to describe the location of buildings to be constructed	Knowing	

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
A.1, 5, 7, C.3	e) use topographical plans to determine elevations of structures and to determine drainage patterns	Knowing	
A.2, 5, 6, C.1 M.1, 5	f) construct floor plan drawings	Applying	
	g) design and draw appropriate related plans, e.g., electrical, plumbing, HVAC construction details		
A.2, 5, 6, C.1 M.1, 5	h) construct elevations to show exterior appearance of structures	Applying	
A.2, 5, 6, C.1 M.1, 5	i) use sectional view drawings to show details of walls and other building features	Knowing	
A.2, 5, 6, C.1 M.1, 5	j) complete a working drawing package that could be given to contractors and necessary agencies	Applying	
A.2, 5, C.3	k) develop a simple specification showing the quality of materials for a residential project	Applying	
A.5, 7, C.3	l) prepare a building cost estimate	Applying	
A.2, 4, 5	m) provide appropriate oral and written communication to support drawings completed	Applying	
A.1, 5, 7, C.3	n) evaluate heat loss and other environmental considerations for a simple structure.	Integrating	
	9. Occupational Information		
A.7, 9, 11, M.2 M.4	a) name ten careers related to architectural drawing and briefly describe the duties of each		
A.7, B.11, M.2 M.4	b) describe job responsibilities of professionals at several levels, e.g., detailer, drafter, estimator, designer, lead person	Knowing	
A.2, 4, C.1, M.1	c) describe how drafters interrelate with other occupations to produce a product	Knowing	
M.2, 3, 4	d) discuss trends in the drafting industry.	Knowing	

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
	10. Gifted/Talented Outcomes		
A.6, 8, B.8, C.1 M.1, 5	a) work with a team to design and build a shelter or warming house after consultation with the park board or athletic association about who will use the product	Applying Integrating Psychomotor	
A.5, C.1, 2, 3	b) design a superinsulated house; conduct a heat loss analysis of this structure	Applying Integrating	
A.6, 8, B.8, C.1 M.1, 5	c) construct an architectural model of a previously designed structure.	Applying Integrating Psychomotor	

Automotive Technician Occupations

Learning experiences concerned with the maintenance and repair of automobiles.

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
	1. Principles of Internal Combustion Engine Operation		
	Students will be able to:		
C.1	a) contrast types and characteristics of energy	Knowing	
C.2	b) identify forms of available energy	Knowing	
C.1	c) describe types of mechanical motion found in engines	Knowing	
A.2, 7, C.2	d) label components of basic internal combustion engines	Knowing	
C.1, 2	e) describe the process by which an internal combustion engine converts chemical energy into rotary motion	Knowing	
C.3	f) assess types of engine design	Integrating	
A.1, C.1	g) interpret model, type, and code numbers found on engines	Integrating	
A.7, C.3	h) identify operating positions of the crankshaft	Knowing	
A.7, C.1, 2	i) recognize factors that determine firing order of a multicylinder engine	Integrating	
C.1, 3	j) analyze the relationship between camshaft lobe, valve timing, and overlap	Integrating	
A.7, C.2	k) identify types of valve arrangements	Knowing	
A.7, C.1	l) identify factors which determine engine timing	Knowing	
A.7, C.2	m) identify exhaust system components.	Knowing	
	2. Gaskets and Sealants		
A.7, C.2	a) identify gasket materials, i.e., paper, rubber, cork, steel, and combinations	Knowing	
A.7, C.2	b) identify sealing compounds	Knowing	

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
A.1, 7, C.1	c) select and use appropriate gaskets and sealants	Applying	
A.1, 7, C.1	d) use technical information to determine proper tightening sequence and torque specifications.	Applying	
	3. Fasteners		
A.7, C.2	a) identify types and grades of fasteners	Knowing	
A.1, 5, 6, 7	b) measure standard/English and metric bolts and threads	Applying	
A.1, 5, 6, 7	c) identify types of washers	Applying	
A.4, C.1, M.1	d) demonstrate methods used to remove a seized nut or a broken bolt or stud	Applying	
A.4, C.1, M.1	e) demonstrate tools to restore internal and external threads.	Applying	
	4. Apply Computational Skills		
A.5	a) apply basic mathematics	Knowing, Applying	
A.5	b) estimate time and costs required to complete a repair	Applying	
C.1, 2	c) interpret charts, graphs, and tables	Applying	
C.1, 2	d) interpret precision measurement data	Integrating, Applying	
A.1, 2, 5, C.1	e) solve problems using the formulas for work, horsepower, and torque	Applying	
A.1, 2, 5, C.1	f) solve problems using the formulas for engine cubic inch displacement and compression ratio.	Applying	
	5. Measuring		
A.7, C.2	a) identify measuring instruments	Knowing	
A.4, 6, C.1	b) demonstrate correct use of precision tools	Knowing	
A.2, 4, 5	c) describe basic units of measurement	Knowing	
A.4, 5, 6, C.1	d) demonstrate steps for reading measuring instruments	Knowing	

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
A.1, 5, C.1	e) convert metric to conventional measurements and vice versa	Applying	
A.1, 5, 6, 7	f) perform measurements using a conventional or metric micrometer, digital micrometer, dial indicator, or telescoping gauge.	Applying	
	6. Electricity		
C.1	a) identify sources of electricity	Knowing	
A.2, 4, C.2	b) name parts of a basic circuit	Knowing	
A.2, C.2	c) list good conductors and insulators of electricity	Knowing	
A.7, C.3	d) differentiate between direct and alternating current	Integrating	
A.1, 7, C.2	e) interpret basic electrical schematic symbols	Integrating	
A.2, 4, 5, C.2	f) define Ohm's law by letter and formula	Knowing	
A.2, 4, C.2	g) name types of electrical circuits	Knowing	
A.1, 2, 5, C.2	h) solve problems using Ohm's law formula	Applying	
A.2, 4, C.2	i) describe rules for series circuits and parallel circuits	Knowing	
C.3	j) determine factors affecting resistance in a conductor	Integrating	
C.2	k) describe relationship between electricity and magnetism	Knowing	
A.1, 5, 6, 7	l) measure voltage, amperage, and resistance with instruments	Applying	
A.1, 5, 6, 7	m) check continuity with appropriate test equipment	Applying	
A.2, 4, C.3	n) describe charging systems	Knowing	
A.7, C.3	o) identify charging system components and functions	Knowing	
A.2, 4, C.2, 3	p) explain reverse polarity	Knowing	
A.6, C.1, M.1	q) remove and replace a generator/alternator	Applying	

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
A.6, C.1, M.1	r) disassemble, check, and reassemble a generator/alternator	Applying	
A.2, 4, C.3	s) describe types of starters	Knowing	
A.6, 7, C.1 M.1	t) remove, disassemble, test, service, and reassemble a mechanical or electrical starter.	Applying	
	7. Ignition Systems		
A.2, 4, C.2, 3	a) explain purpose and operation of the ignition system	Knowing	
C.2	b) identify types of ignition systems	Knowing	
A.2, 4, 7, C.2, 3	c) differentiate between components of a primary and secondary battery ignition circuit	Integrating	
A.7, C.2	d) recognize components of the standard ignition system	Knowing	
A.7, C.3	e) analyze components of a solid state ignition system	Integrating	
A.7, C.2	f) recognize components of a breakerless ignition system	Knowing	
A.6, C.1, M.1	g) remove, service, and replace spark plugs	Applying	
A.6, C.1, M.1	h) remove and replace contact points and condenser	Applying	
A.6, C.1, M.1	i) test the coil, condenser	Applying	
A.6, C.1, M.1	j) test a solid state ignition system	Applying	
A.6, 7, C.1 C.2, 3, M.1	k) check and adjust ignition timing using a dial indicator or timing light.	Applying	
	8. Electronic Control Systems		
C.2	a) identify components	Knowing	
A.2, 4, C.2	b) describe operation	Integrating	
A.6, C.1	c) operate test equipment	Applying	
A.1, 6, 7, C.2	d) diagnose system	Integrating	
A.6, C.1, M.1	e) remove and replace components.	Applying	

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
	9. Fuel and Induction Systems		
A.2, 4, C.2	a) describe purpose of the fuel system	Knowing	
C.2	b) identify basic types and components of fuel supply systems	Knowing	
A.2, 4, C.2	c) describe types of carburetors	Knowing	
A.2, 4, 7, C.1 M.1	d) identify and service fuel filters	Knowing	
A.7	e) recognize types of fuel pump action	Knowing	
A.2, 4, 7, C.1 M.1	f) identify and service air cleaners	Applying	
C.1, M.1	g) service a carburetor	Applying	
A.6, 7, C.1 M.1	h) test and service a fuel pump	Applying	
A.2, C.2	i) list components of an electronic fuel injection system	Knowing	
A.6, 7, C.1 M.1	j) service the fuel delivery system on an electronic fuel injection engine.	Applying	
	10. Lubrication Systems		
A.2, 4, C.2, 3	a) explain types of lubrication systems	Knowing	
A.2, 4, C.2	b) describe purpose of the crankcase breather and service components	Knowing	
A.2, 4, C.3	c) define characteristics of a good lubricant, i.e., oil, grease	Knowing	
A.7, C.3	d) recognize oil specifications, i.e., SAE viscosity numbers, API classification system, oil additives	Knowing	
A.1, 7, C.1, 3	e) select and use oils for best engine performance following manufacturer's recommendation	Applying	
C.1, M.1	f) perform lubrication service and engine oil and filter change.	Applying	

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
	11. Cooling		
C.2	a) identify components of the cooling system	Knowing	
A.2, 4, C.2	b) describe functions of the cooling system	Integrating	
A.2, 4, C.2	c) describe causes of overheating	Knowing	
A.6, 7, C.1 M.1	d) inspect, remove, clean, and replace cooling system parts.		
	12. Speed Control Systems		
A.2, 4, C.2	a) describe purposes of speed control systems	Integrating	
A.7, C.2, 3	b) differentiate between components of speed control/governor systems and their purposes	Integrating	
A.6, 7, C.1 M.1	c) inspect, adjust, and repair a speed control system.	Applying	
	13. Exhaust Systems		
A.2, 4, C.2	a) describe danger of operating an engine in a closed shop	Knowing	
C.2	b) identify types of exhaust systems	Knowing	
A.7, C.2, 3	c) diagnose condition of exhaust system	Integrating	
A.6, 7, C.1 M.1	d) remove, service, and replace exhaust system components.	Applying	
	14. Air pollution/emissions		
A.2, 4, C.2, 3	a) describe past, present, and future trends in emission control devices	Knowing, Affective International/Global	
C.2, 3	b) identify harmful exhaust gases released into atmosphere	Knowing	
C.2, 3	c) identify how emissions are controlled at the crankcase, carburetor, fuel tank, and exhaust pipe	Knowing	
A.6, C.1, M.1	d) perform basic emissions tests	Applying	
A.6, C.1, M.1	e) service emissions equipment on vehicle	Applying	

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
B.6, 7, 10	f) analyze the impact the automobile has on the environment.	Integrating	
	15. Steering and Suspension		
A.5, C.2	a) identify tire size and type information	Knowing	
C.2	b) identify suspension components	Knowing	
A.2, 4, C.2, 3	c) describe function of suspension components	Knowing	
A.6, C.1, M.1	d) operate tire changing and balancing equipment	Applying	
A.6, C.1, M.1	e) perform alignment service	Applying	
A.6, C.1, M.1	f) remove and replace steering and suspension components.	Applying	
	16. Brakes		
A.7, C.2, 3	a) identify components and operation of brake systems	Knowing	
A.6, C.1, M.1	b) operate brake servicing equipment	Applying	
A.6, C.1, M.1	c) remove and replace components of brake systems	Applying	
A.6, C.1, M.1	d) adjust brakes.	Applying	
	17. Driveability/Performance		
A.7, C.2, 3	a) recognize common driveability/performance problems, i.e., pinging, hesitation, lack of power, fuel economy problems, and hard starting	Integrating	
C.2, 3	b) analyze problems using flow charts, trouble trees, and technical manuals	Integrating	
A.6, C.1, M.1	c) correct problems according to manufacturer's specifications.	Applying	
	18. Transmissions		
C.2	a) identify types	Knowing	
A.2, 4, C.2	b) describe components and functions	Knowing	
A.6, C.1, M.1	c) diagnose and correct system malfunctions	Integrating	

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
A.6, C.1, M.1	d) service components.	Applying	
	19. Diagnostic and Testing Equipment		
A.7	a) recognize capabilities of various types of test equipment	Knowing	
A.6	b) connect test leads properly	Applying	
A.6, C.2	c) make accurate readings	Applying	
C.1, 2, 3	d) interpret readings from test equipment	Integrating	
A.6, 7, C.1, M.1	e) adjust, repair, or replace according to specifications.	Applying	
	20. Preventive Maintenance		
A.6, C.1, 2, 3 M.1	a) clean, lubricate, service, and/or replace components, i.e., filters, spark plugs, belts, and bearings in accordance with owners manual	Applying	
A.6, C	b) dispose of waste fluids and materials according to government regulations.	Applying, Affective	
	21. Technical Manuals/Information Systems		
A.5, C.2	a) identify sources of technical information	Knowing	
C.1, 2, 3	b) interpret technical information	Integrating	
A.6, 7, C.1 C.2, 3	c) apply technical information to correct problems or restore to original performance specifications	Integrating	
A.1, 5	d) use flat rate manuals to determine repair costs.	Applying	
	22. Parts Management		
A.5, C.2	a) identify types of information found in parts catalogs	Knowing	
A.2, 4, C.2, 3	b) describe common parts and their abbreviations	Knowing	
A.2, 7, C.1	c) list steps in using a parts catalog	Knowing	
A.1, 2, 4, 5, 7 C.1	d) demonstrate how to price parts correctly	Knowing	

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
A.1, 2, 4, 7 C.1	e) use the microfiche system to identify a part	Applying	
A.2, 4, C.2, 3	f) describe uses for computers in inventory control, stocking, and pricing	Knowing	
A.2, 7, C.1	g) establish guidelines for completing a physical inventory	Integrating	
A.2, 5, 7, C.1	h) compile information and complete a service order.	Applying	
	23. Occupational Information		
B.9, I.1, 2 J.6, K.4, 5 M.4	a) name ten careers in automotive technician occupations and briefly describe the duties of each	Knowing, Affective	
A.7, B.11 M.2, 4	b) identify job entry requirements for careers in the automotive technician field.	Knowing	
	24. Gifted/Talented Outcomes		
A.6, 7, C.1 C.2, 3, M.1	a) participate with a team of students to design, build, and test a supermileage vehicle for competition at the state level	Knowing, Applying Integrating Psychomotor Affective	
A.6, 7, C.1 C.2, 3, M.1	b) identify the scientific principles present in an automobile carburetor, or in a fuel injection system, and develop a chart illustrating those principles	Knowing, Applying Integrating	
C.1, 2, 3	c) relate automobile economy to cold weather operation, driveability, riding comfort, size, cost, style, and useful vehicle life, and prepare a consumer guide	Knowing, Applying Integrating	
A.7, C.1, 2, 3 M.1	d) analyze the relationship between the thermal, electronic, fluidal, and mechanical systems in a modern–day automobile and predict the changes in these systems in the future.	Knowing, Applying Integrating Affecting	

Carpentry Occupations and Finishing Trades

Learning experiences concerned with rough carpentry and residential interior finishing.

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
	1. Planning		
	Students will be able to:		
A.1, 5, 7, C.1 C.2, 3, M.1	a) identify factors affecting decisions to buy vs. build a home	Knowing, Affective	
A.1, 5, 7, C.1 C.2, 3, M.1	b) identify planning factors such as square footage needs, house style, and location	Knowing Integrating	
A.5, 7	c) identify home financing considerations.	Knowing, Applying	
	2. Apply Computational Skills		
A.5	a) apply basic mathematics to calculate area and volume, compute interest, and estimate materials, time, and costs	Knowing, Applying	
C.1, 2	b) interpret charts, graphs, and tables.	Applying	
	3. Interpreting Plans		
A.1, 5, 7, C.1 C.3	a) interpret floor plans and sectional views from blueprints	Integrating	
A.1, 5, 7, C.1 C.3	b) interpret window and door schedules from blueprints	Integrating	
A.1, 5, C.3	c) read and interpret specifications	Integrating	
A.1, 5, 7, C.1 C.3	d) demonstrate knowledge of building codes.	Knowing	
	4. Environmental Considerations		
A.1, 2, 4, 7	a) identify local ordinances and zoning regulations	Knowing	
B.6, 7, 10	b) analyze impacts of land clearing, excavation, products consumed, and waste disposal.	Integrating	
	5. Building Site Layout and Preparation		
A.5, 6, M.1	a) use transit to step elevations.	Applying	

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
	6. Scaffolds, Ladders, and Rigging		
A.6, C.1, M.1	a) demonstrate proper setup procedures for scaffolds, ladders, and riggings	Applying	
C.1	b) practice proper safety procedures in the use of scaffolds, ladders, and riggings.	Applying, Affective	
	7. Form Work and Concrete		
A.5, 6, C.1 M.1, 5	a) construct forms.	Applying	
	8. Wood Foundations		
A.1, 5, 7, C.3	a) identify materials used for wood foundations.	Knowing	
	9. Framing		
A.5, 6, 7, C.1 M.5	a) layout, cut, and assemble floor system according to plan	Applying	
A.5, 6, 7, C.1 M.5	b) layout, cut, and assemble wall system according to plan	Applying	
A.5, 6, 7, C.1 M.5	c) layout, cut, and assemble roof system according to plan	Applying	
A.5, 6, 7, C.1 M.5	d) layout, cut and assemble stair system according to plan.	Applying	
	10. Exterior Finish		
A.1, 5, 7, C.3	a) identify types of exterior finish materials	Knowing	
A.5, 6, C.1, M.5	b) install soffit	Applying	
A.5, 6, C.1, M.5	c) install shingles	Applying	
A.5, 6, C.1, M.5	d) install windows and exterior doors	Applying	
A.5, 6, C.1, M.5	e) install siding.	Applying	
	11. Energy Conservation Factors		
A.1, 5, 7, C.3	a) identify types of insulation materials and their use	Knowing	
A.1, 5, 7, C.3	b) identify types of vapor barriers and their use	Knowing	

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
A.6, C.1, 3, M.5	c) install insulation, vapor barrier, and roof venting according to code		
A.7, C.3	d) identify different types of construction systems for energy conservation.	Knowing, Affective	
	12. Finishing Trades		
A.1, 5, 7, C.3	a) identify types of interior finish materials	Knowing	
A.5, 6, C.1 M.1, 5	b) hang and screw gypsum board	Applying	
A.5, 6, C.1 M.1, 5	c) install interior doors	Applying	
A.5, 6, C.1 M.1, 5	d) install cabinet systems	Applying	
A.5, 6, C.1 M.1, 5	e) install trim.	Applying	
	13. Painting and Decorating		
A.6, C.1, 3, M.5	a) apply interior wall and wood finishes	Applying	
A.6, C.1, 3, M.5	b) apply gypsum board finishes	Applying	
A.6, C.1, 3, M.5	c) apply exterior wall finishes.	Applying	
	14. Floor Coverings		
A.1, 7, C.3	a) identify various types of floor coverings	Knowing	
A.1, 6, 8, B.8 M.5	b) select and install floor coverings.	Integrating, Applying	
	15. Manufactured Components		
A.7, B.9, F.2 M.2, 4	a) contrast construction occupations in manufactured components to onsite construction jobs	Integrating	
A.7, C.1, 2, 3 M.1	b) identify advantages and disadvantages of manufactured components compared to those fabricated onsite.	Knowing, Integrating	
	16. Remodeling		
A.6, C.1, 2, 3 J.6, M.1, 5	a) perform structural repairs	Applying	

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
A.6, C.1, 2, 3 J.6, M.1, 5	b) construct additions	Applying	
A.6, C.1, 2, 3 J.6, M.1, 5	c) retrofit to meet codes.	Applying	
	17. Job Ethics		
F.2, I.1, 2, M.6	a) identify appropriate job attitudes and behaviors	Knowing, Affective	
B.12, C.3	b) evaluate personal work ethic against recognized performance standards.	Applying Integrating	
	18. Occupational Information		
B.9, I.1, 2, J.6 K.4, 5, M.4	a. name ten carpentry–related careers and briefly describe the duties of each	Knowing, Affective	
A.7, B.11, M.2 M.4	b. identify job entry requirements for careers in the construction trades.	Knowing	
	19. Gifted Outcomes		
A.6, M.1, 2 M.5, 6	a) master a process such as gypsum board taping, electrical wiring, plumbing, or sheet metal work as part of a construction project	Knowing, Applying Psychomotor	
A.6, 8, B.8 C.1, M.1, 5	b) work with a team to construct a storage shed for resale	Applying Integrating Psychomotor	
A.6, 8, B.8 C.1, M.1, 5	c) work with a team to design and build a shelter house or warming house after consultation with the park board or athletic association who will use the product.	Applying Integrating Psychomotor	

Construction—General

Construction occupations. Learning experiences concerned all major phases of residential construction.

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
	1. Planning		
	Students will be able to:		
A.1, 5, 7, C.1 C.2, 3, M.1	a) identify factors affecting decisions to buy vs. build a home	Knowing Affective	
A.1, 5, 7, C.1 C.2, 3, M.1	b) identify planning factors such as square footage needs, house style, and location	Knowing, Integrating	
A.5, 7	c) identify home financing considerations	Knowing, Applying	
C.1, 2, 3	d) plan construction schedules.	Applying	
	2. Apply Computational Skills		
A.5	a) apply basic mathematics to calculate area and volume, compute interest, and estimate materials, time, and costs	Knowing, Applying	
C.1, 2	b) interpret charts, graphs, and tables.	Applying	
	3. Interpreting Plans		
A.1, 5, 7, C.1 C.3	a) interpret floor plans and sectional views from blueprints	Integrating	
A.1, 5, 7, C.1 C.3	b) interpret window and door schedules from blueprints	Integrating	
A.1, 5, C.3	c) read and interpret specifications	Integrating	
A.1, 5, 7, C.1, 3	d) demonstrate knowledge of building codes.	Knowing	
	4. Environmental Considerations		
A.5, 7, B. 6, 7, 8	a) identify factors such as noise pollution, water/sewage, geological factors, building location, drainage, and landscaping that affect site development	Knowing, Affective	
A.1, 2, 4, 7	b) identify local ordinances and zoning regulations	Knowing	
B.6, 7, 10	c) analyze impacts of land clearing, excavation, products consumed, and waste disposal.	Integrating	

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
	5. Building Site Layout and Preparation		
A.5, 6, M.1	a) use transit to layout building site	Applying	
A.5, 6, M.1	b) use transit to step elevations	Applying	
A.6	c) complete necessary excavation.		
	6. Scaffolds, Ladders, and Rigging		
A.6, C.1, M.1	a) demonstrate proper set–up procedures for scaffolds, ladders, and riggings	Applying	
C.1	b) practice proper safety procedures in the use of scaffolds, ladders, and riggings.	Applying, Affective	
	7. Form Work and Concrete		
A.5, 6, C.1 M.1, 5	a) construct forms	Applying	
A.6, C.3, M.1	b) identify and use appropriate reinforcement materials	Applying	
A.6, C.1, M.1	c) pour and finish concrete using safe handling procedures.	Applying	
	8. Masonry		
A.5, 6, C.1, 2, 3	a) mix mortar to proper consistency	Applying	
A.5, 6, C.1 M.1, 5	b) lay masonry units according to specifications	Applying	
A.7	c) expose students to proper waterproofing procedures.	Knowing	
	9. Wood Foundations		
A.1, 5, 7, C.3	a) identify materials used for wood foundations	Knowing	
A.1, 5, 7, C.3	b) identify size requirements for wood foundations	Knowing	
A.1, 5, 7, C.3	c) identify waterproofing techniques for wood foundations.	Knowing	
	10. Framing		
A.5, 6, 7, C.1 M.5	a) layout, cut, and assemble floor system according to plan	Applying	

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
A.5, 6, 7, C.1 M.5	b) layout, cut, and assemble wall system according to plan	Applying	
A.5, 6, 7, C.1 M.5	c) layout, cut, and assemble roof system according to plan	Applying	
A.5, 6, 7, C.1 M.5	d) layout, cut, and assemble stair system according to plan.	Applying	
	11. Exterior Finish		
A.1, 5, 7, C.3	a) identify types of exterior finish materials	Knowing	
A.5, 6, C.1, M.5	b) install soffit	Applying	
A.5, 6, C.1, M.5	c) install shingles	Applying	
A.5, 6, C.1, M.5	d) install windows and exterior doors	Applying	
A.5, 6, C.1, M.5	e) install siding.	Applying	
	12. Plumbing		
A.1, 5, 6, C.1 M.5	a) identify types of plumbing materials and their uses	Applying	
A.1, 5, 6, C.1 M.5	b) rough in waste systems according to code	Applying	
A.1, 5, 6, C.1 M.5	c) rough in water supply system according to code	Applying	
A.1, 5, 6, C.1 M.5	d) install plumbing fixtures.	Applying	
	13. Mechanical Trades		
A.7, C.3	a) identify duct or pipe systems for heating	Knowing	
A.7, C.3	b) identify duct systems for air conditioning	Knowing	
A.7, C.3	c) identify duct systems for ventilation	Knowing	
A.7, C.3	d) identify various types of mechanical units in heating, air conditioning, and ventilation.	Knowing	
	14. Electrical Trades		
A.7, C.3	a) identify service entrance	Knowing	
A.5, 7, C.1, 2, 3	b) identify openings and wire according to code	Knowing	
A.5, 6, C.1 M.1, 5	c) install electrical devices.	Applying Psychomotor	

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
	15. Energy Conservation Factors		
A.1, 5, 7, C.3	a) identify types of insulation materials and their use	Knowing	
A.1, 5, 7, C.3	b) identify types of vapor barriers and their use	Knowing	
A.1, 5, 7, C.3	c) complete a heat loss analysis of structure	Knowing	
A.6, C.1, 3, M.5	d) install insulation, vapor barrier, and roof venting according to code		
A.7, C.3	e) identify different types of construction systems for energy conservation.	Knowing, Affective	
	16. Finishing Trades		
A.1, 5, 7, C.3	a) identify types of interior finish materials	Knowing	
A.5, 6, C.1 M.1, 5	b) hang and screw gypsum board	Applying	
A.5, 6, C.1 M.1, 5	c) install interior doors	Applying	
A.5, 6, C.1 M.1, 5	d) install cabinet systems	Applying	
A.5, 6, C.1 M.1, 5	e) install trim.	Applying	
	17. Painting and Decorating		
A.6, C.1, 3, M.5	a) apply interior wall and wood finishes	Applying	
A.6, C.1, 3, M.5	b) apply gypsum board finishes	Applying	
A.6, C.1, 3, M.5	c) apply exterior wall finishes.	Applying	
	18. Floor Coverings		
A.1, 7, C.3	a) identify various types of floor coverings	Knowing	
A.1, 6, 8, B.8, M.5	b) select and install floor coverings.	Integrating, Applying	
	19. Manufactured Components		
A.7, B.9, F.2 M.2, 4	a) contrast construction occupations in manufactured components to onsite construction jobs	Knowing	

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
A.7, C.1, 2, 3 M.1	b) identify advantages and disadvantages of manufactured components compared to those fabricated onsite.	Knowing, Integrating	
	20. Remodeling		
A.6, C.1, 2, 3 J.6, M.1, 5	a) perform structural repairs	Applying	
A.6, C.1, 2, 3 J.6, M.1, 5	b) construct additions	Applying	
A.6, C.1, 2, 3 J.6, M.1, 5	c) retrofit to meet codes.	Applying	
	21. Job Ethics		
F.2, I.1, 2, M.6	a) identify appropriate job attitudes and behaviors	Knowing, Affective	
B.12, C.3	b) evaluate personal work ethic against recognized performance standards.	Integrating Affective	
	22. Occupational Information		
B.9, I.1, 2, J.6 K.4, 5, M.4	a. name ten carpentry–related careers and briefly describe the duties of each	Knowing, Affective	
A.7, B.11, M.2 M.4	b. identify job entry requirements for careers in the construction trades.	Knowing	
	23. Gifted/Talented Outcomes		
A.6, M.1, 2 M.5, 6	a) master a process such as gypsum board taping, electrical wiring, plumbing, or sheet metal work as part of a construction project	Knowing, Applying Psychomotor	
A.6, 8, B.8 C.1, M.1, 5	b) work with a team to construct a storage shed for resale	Applying Integrating Psychomotor	
A.6, 8, B.8 C.1, M.1, 5	c) work with a team to design and build a shelter house or warming house after consultation with the park board or athletic association who will use the product	Applying Integrating Psychomotor	
A.5, C.1, 2, 3	d) design a superinsulated house; conduct a heat loss analysis of this structure.	Applying Integrating	

Electronic Occupations

Learning experiences concerned with the design, construction, maintenance, troubleshooting, and repair of electronic devices.

1. Fundamental Electronic Theory

Students will be able to:

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
L.1, M.1	a) demonstrate correct electrical safety practices	Applying	
A.1, 3, 7, C.2	b) identify three atomic particles using Bohr's model of the atom	Knowing	
A.1, 3, 7, C.2	c) explain Coulomb's law and the behavior of like and unlike charges	Knowing	
A.2, 4, C.3, M.1	d) define electron theory	Knowing	
A.2, C.3	e) list the common sources of electricity	Knowing	
A.2, 4, M.1	f) define the terms orbital, shell, valence shell, conductor, insulator, drift	Knowing	
A.2, 5, C.2	g) given polarity and magnitude, calculate the direction of current flow in a circuit	Applying	
A.2, 4, M.1	h) define electromotive force, potential difference, voltage and amperage	Knowing	
A.2, 5, C.2	i) given the magnitude and polarity, determine if a potential difference (voltage) exists	Applying	
A.2, 5, C.2	j) draw the symbols for a battery, lamp, resistor, conductor, and switch	Applying	
C.3	k) identify the proper connection points on a circuit for an ammeter and voltmeter using correct polarity	Knowing	
A.2, 5, C.2	l) draw basic schematic symbols for generators (AC and DC), transformer, connected and not connected conductors, variable resistors, inductor, capacitor, diode, and transistor	Applying	
C.1	m) identify a resistor's value and tolerance by using a color code	Knowing	

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
A.2, C.3	n) list four factors that determine the resistance of a substance	Knowing	
A.5, C.2	o) calculate total resistance for resistors in series, parallel, and combined series/ parallel circuits.	Applying	
	2. Apply Computation Skills		
A.5	a) apply basic mathematics and algebra	Knowing	
C.1, 2	b) interpret charts, graphs, tables	Applying	
A.5	c) use formulas to solve a variety of electronic calculation problems.	Applying	
	3. Direct Current Circuits		
A.2, 4, M.1	a) define the following types of circuits: series, parallel, combination, voltage divider, and bridge	Knowing	
A.5	b) apply Kirchoff's law for current	Applying	
A.5	c) apply Kirchoff's law for voltage	Applying	
A.5, C.3	d) demonstrate the application of Ohm's law	Applying	
A.5, C.3	e) calculate voltage drops in series and parallel circuits	Applying	
A.5, C.1	f) calculate power for components by selecting correct formula	Applying	
A.2, 4, M.1	g) define joule, work, power, watt, and dissipation	Knowing	
A.6, C.1	h) demonstrate the application of magnetism.	Applying	
	4. Alternating Current Circuits and Devices		
A.1, 3, 7, C.2	a) identify the different wave forms of AC	Knowing	
A.6, C.1, M.1	b) demonstrate uses of AC and how it compares to DC	Applying	
C.1	c) identify reactive components used in an AC circuit	Knowing	
A.5, C.1	d) calculate the RMS, peak, P/D and instantaneous value of an AC wave	Applying	

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
A.6, M.1	e) operate signal/function generator	Applying	
A.5, 6, M.1	f) measure AC using a voltmeter and ammeter	Applying	
A.5, 6, C.1, M.1	g) measure an AC wave using an oscilloscope	Applying	
A.5, C.2	h) apply use of vectors to solve reactive circuits	Applying	
A.5, 6, C.1, M.1	i) construct an inductive circuit	Applying	
A.5, C.2	j) solve for phase angle and impedance for an RL circuit	Applying	
A.6, C.2, M.1	k) apply uses of a transformer	Applying	
A.6, C.1, M.1	l) construct a capacitive circuit	Applying	
A.5, C.2	m) solve for impedance and phase angle in an RD circuit	Applying	
A.6, C.1, M.1	n) construct an RLC circuit in series and in parallel	Applying	
A.2, 4, C.3, M.1	o) define resonance	Knowing	
A.5, C.2	p) calculate the resonant frequency of a circuit	Applying	
A.5, C.2	q) demonstrate the effects of series and parallel resonance.	Applying	
	5. Residential and Construction Electricity		
L.1, M.1	a) demonstrate safe practices in electrical wiring	Applying	
A.1, 5, 6, 7	b) read and interpret information from kilowatt hour meters	Applying	
A.5, C.2	c) calculate the kilowatt hours consumed by home appliances	Applying	
A.1, 3, 7, C.2	d) identify the systems used to generate electricity for distribution	Knowing	
A.1, 3, 7, C.2	e) identify the systems (high voltage lines) used to distribute electricity to customers	Knowing	
A.1, 3, 7, C.2	f) identify different service entrances that can be used	Knowing	

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
A.1, 3, 7, C.2	g) identify different stages of electrical construction such as rough-in and final	Knowing	
A.1, 3, 7, C.2	h) identify tools used in electrical construction	Knowing	
A.1, 3, 7, C.1	i) determine the size and type of conductor required for different applications	Applying	
A.6, C.1	j) demonstrate proper conductor preparation for splicing or connection to devices	Applying	
A.1, 3, 5, 7, C.1 M.1	k) identify the proper protection devices needed for each circuit	Knowing	
A.1, 3, 7, C.1 M.1	l) identify purpose, intent, and application of the National Electrical Code	Knowing	
A.5, 6, C.1, M.1	m) construct a variety of common low voltage and line voltage residential wiring circuits.	Applying	
	6. Semiconductor Devices		
A.2, 6, C.1	a) draw a PN junction and show the direction of travel for the charge carriers	Applying	
A.6, C.2	b) identify the anode and cathode leads of diodes by testing with an ohmmeter	Knowing	
A.2, 4, C.1, M.1	c) describe the production of a semiconductor material	Knowing	
A.1, 3, 7, C.2	d) identify the different types of diodes	Knowing	
A.5, 6, C.1, M.1	e) construct and test common rectifier circuits and analyze their output voltages	Applying	
A.1, 6, 7, C.1	f) draw schematic symbols and leads for NPN and PNP transistors and N and P channel FETS	Applying	
A.6, C.2	g) determine the correct polarity for various transistor terminals using an ohmmeter	Applying	
A.5, C.2	h) calculate Beta and collector dissipation from data and characteristic curves	Applying	
A.6, C.1, M.1	i) construct a C-E and a C-C amplifier		
A.6, C.1, 2, 3 M.1	j) troubleshoot a C-3 amplifier with a distorted output signal	Integrating	

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
A.6, C.1, M.1	k) construct a differential amplifier and an operational amplifier	Applying	
A.1, 3, 7, C.2	l) identify operational amplifier applications	Knowing	
A.6, C.2, M.1	m) localize difficulties in the signal by using signal tracing techniques	Applying	
C.1, 2, 3	n) analyze filtering and regulation in power supply circuits	Integrating	
A.1, 3, 7, C.2	o) identify the uses of integrated circuits and special devices.	Knowing	
	7. Industrial Control Systems		
A.1, 3, 7, C.2	a) identify the schematic symbols for SCRS, TRIACS, and DIACS	Knowing	
A.2, 4, 7, C.1 M.1	b) explain the operation of SCRS, TRIACS, DIACS	Knowing	
A.6, C.1, M.1	c) construct a TRIAC circuit with a DIAC trigger	Applying	
A.6, C.1	d) demonstrate the advantages of full wave control	Applying	
A.2, 4, C.1, 2, 3 M.1	e) explain the advantages and disadvantages of electronic switching in power control circuits	Integrating	
A.6, C.1, M.1	f) construct an electromechanical relay circuit with a resistive load	Applying	
A.6, C.1, 2, 3 M.1	g) troubleshoot an electromechanical relay circuit with a resistive load	Integrating	
A.1, 3, 7, C.2	h) analyze an SCR circuit in terms of its conduction angle and commutation	Integrating	
A.7, C.1	i) compare the range of movement and system of control of two different types of robotic arms	Integrating	
A.2, 7, C.1	j) draw a block diagram of a servomotor circuit	Applying	
A.2, 7, C.1	k) draw a block diagram of a steppermotor circuit.	Applying	

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
	8. Digital/Logic Systems		
A.5, C.2	a) convert whole numbers from binary to decimal and decimal to binary	Applying	
A.5, C.2	b) convert decimal to binary and hexidecimal; binary to decimal and hexidicimal; and hexidecimal to decimal and binary	Applying	
A.1, 7, C.2	c) write the Boolean expression for the seven basic logic gates and draw the symbol and truth table for each gate	Knowing	
A.1, 7, C.1	d) identify manufacturer's symbols and pin numbers on DIP integrated circuits	Knowing	
A.6, C.1, M.1	e) construct an encoder/decoder system that converts from decimal to BCD, BCD to decimal	Applying	
A.1, 5, 7, C.3	f) present the output from an encoder/decoder system that converts from decimal to BCD, BCD to decimal on a seven-segment display	Applying	
	g) identify five characteristics of the 7400 family of logic gates	Knowing	
	h) construct a D-type flip-flop	Applying	
A.1, C.2	i) draw a truth table	Applying	
A.6, C.1, 2, 3	j) construct a 4-bit serially loaded shift register and analyze for proper operation	Applying	
A.1, C.2	k) draw the block diagram of a microprocessor.	Applying	
	9. Computer/Information Technology		
A.1, C.2	a) diagram the basic blocks of a digital computer	Applying	
A.2, 4, 5, 7, C.2	b) explain the function of the basic parts of a digital computer	Knowing	
A.2, 4, 5, 7, C.2	c) explain how a microprocessor works	Knowing	
A.6, C.1, 2, 3	d) analyze, troubleshoot, and/or repair digital computer devices	Integrating	

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
A.1, 7, C.1	e) identify the coding groups associated with digital computers	Knowing	
A.1, 3, C.1	f) describe the various types and uses of computer peripherals	Knowing	
A.6, C.1, M.1	g) interface peripheral equipment with a computer	Integrating	
A.6, M.1	h) operate an interfaced computer device	Applying	
A.6, C.1, 2, 3 L.1, M.1	i) employ diagnostic tests to analyze, calibrate, or repair digital computer equipment	Integrating	
A.1, 3, C.1	j) describe data transmission methods used in the computer/information technology areas	Knowing	
A.4, 6, C.1, L.1 M.1	k) demonstrate correct safety and care practices in conducting computer activities and exercises	Applying	
A.1, 3, 5, 7, C.1 C.2, 3, M.1	l) develop problem-solving skills and creative thinking abilities through solving computer technology problems	Integrating	
A.6, C.1, M.1	m) use computer and information technology equipment to transmit, receive, and store data.	Applying	
	10. Electronic Communication Technology		
A.1, 3, C.1	a) describe basic concepts of the communication process such as encoding, transmission, carriers, receivers, and decoding	Knowing	
A.1, 6, C.1	b) use Morse code to send a message	Applying	
A.2, 4, 7, C.2, 3	c) identify technological developments in communications	Knowing	
A.6, C.1, M.1	d) construct a transmitter and/or receiver	Applying	
A.1, 7, C.1	e) identify electronic communication mediums	Knowing	
A.1, 3, 7, C.2, 3	f) distinguish between major electronic communication subsystems	Integrating	

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
A.1, 2, 3, 4, 5 A.6, 7, C.1, 2, 3 J.6, M.1	g) develop problem-solving skills and creative-thinking skills through solving communication problems	Knowing, Integrating	
A.2, 4, 7, C.2, 3	h) identify the basic systems and functions of radio, television, and telecommunications systems	Knowing	
A.6, C.1, M.1	i) use equipment to transmit, receive, and store electronic messages	Applying	
A.1, 3, C.1, 2, 3 M.1	j) describe transmission and receiving equipment and processes such as antennas, microwave signals, lasers, and fiber optic systems	Knowing	
L.1, M.1	k) practice correct safety practices in conducting communication exercises	Applying, Affective	
A.1, 3, C.1, 2, 3 M.1	l) describe applications of communication technology in industry, business, government, and education	Knowing	
A.1, 3, 7, C.2, 3	m) identify developments from the past and future which will significantly effect the growth of radio, television, and telecommunications	Knowing	
A.1, 3, 7, C.2, 3	n) describe examples of modern communication systems and devices	Knowing	
A.2, 4, C.3, M.1	o) define telecommunications terms such as satellites, lasers, holography, and magnetic bubbles.	Knowing	
	11. Electrical and Electronic Careers		
B.9, I.1, 2, J.6 K.4, 5, M.4	a) name ten electronics-related careers and briefly describe the duties of each	Knowing, Affective	
A.7, B.11, M.2, 4	b) identify entry-level skills and knowledge needed for electronic careers	Knowing	
A.7, B.11, M.2, 4	c) identify a variety of hobby and leisure-time activities in electricity and electronics	Knowing	
A.7, B.11, M.2, 4	d) examine a variety of educational programs for career preparation, job retention, and advancement objectives	Integrating	

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
A.5, 7	e) identify electronics career concerns regarding pollution, finite resources, cultural values, ethics, and stereotypes	Knowing, Affective International/Global	
	12. Gifted/Talented Outcomes		
A.5, 7, C.1, 2, 3	a) estimate the monthly electrical power consumption of the building in which the classroom is situated	Knowing, Applying Integrating	
A.5, B.8, C.1, 2 C.3, M.1	b) design an electronic device to perform a specific task	Knowing, Applying Integrating	
A.7, C.1, 2, 3 M.1	c) troubleshoot and repair a computer	Knowing, Applying Integrating	
A.5, B.8, C.1, 2 C.3	d) design a computer system for a specific task or operation	Knowing, Applying Integrating	
A.5, B.8, C.1, 2 C.3	e) design a communication system for your school using the latest technologies.	Knowing, Applying Affective	

Graphic Communication Occupations

Learning experiences concerned with the design, preparation, printing and assembly of printed materials, including photography and commercial artwork

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
	1. Major Printing Processes		
	Students will be able to:		
A.1, 2, 3, 4 A.5, 7	a) describe the four major printing processes (i.e., relief, intaglio, lithography, and screen)	Knowing	
C.1, 2, 3, 5 J.6, M.1	b) select the best printing process based on job criteria	Applying	
B.9, 10, 11 K.4, 5, M.2, 4	c) identify career opportunities within the four major printing areas	Knowing, Applying	
A.2, 4, B.9, K.5	d) describe postsecondary education options.	Knowing	
	2. Layout and Design		
A.7, B.8, C.1 C.2, 3, 5	a) demonstrate knowledge of principles of design	Integrating	
A.8, M.1, 5	b) select typestyles appropriate to the message	Knowing, Affective	
A.8, C.5	c) produce thumbnails, roughs, and comprehensive layouts	Integrating	
A.6, M.1	d) demonstrate appropriate use of layout and design instruments.	Knowing	
	3. Apply Computational Skills		
A.5	a) apply basic mathematics	Knowing	
A.5, C.1, 2, 3	b) estimate materials, time, and costs	Applying	
C.1, 2	c) interpret charts, graphs, and tables.	Applying	
	4. Color Theory		
M.1	a) list applications of the additive/subtractive color	Applying	
B.8, C.2, 3, 5	b) select color(s) appropriate to the message	Applying, Affective	
C.3, M.1	c) demonstrate knowledge of color separation techniques	Integrating	

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
A.2, 4, M.1	d) describe the four-color process methods of printing.	Knowing	
	5. Computer–Generated Type and Graphics		
A.6	a) operate common computer equipment	Applying	
C.1, 2, 3, M.1	b) select and use appropriate software for task to be performed	Knowing, Integrating	
A.6, B.8, C.3 C.5, M.1	c) apply design techniques to computer–generated type/artwork	Integrating, Applying	
A.6, B.8, C.1 M.1	d) solve layout and design problems with the computer	Integrating, Applying	
A.6, C.1, 2, 3 M.1	e) produce copy for reproduction using conventional and desktop publishing methods	Applying	
J.6, M.1, 5	f) proofread copy.	Knowing	
	6. Copy Preparation/Production Art		
A.6, C.1, 2, 3 M.1	a) produce camera ready copy using paste–up procedures	Applying	
A.6, 7,8, B.8	b) use appropriate methods to size copy	Applying	
A.6, M.1	c) demonstrate appropriate use of keylining techniques	Applying	
A.6, M.1	d) prepare copy using photomechanical transfer process.	Applying	
	7. Continuous Tone Photography		
A.7, 8, B.8 C.2, 5	a) use composition techniques to produce photographs	Applying	
C.1, 3	b) select appropriate film for intended use	Applying	
C.3	c) determine correct exposure	Applying	
A.7, 8, B.8, C.2	d) demonstrate lighting techniques	Integrating	
C.3	e) using appropriate darkroom techniques to process film and produce transparencies and/or prints	Applying	
A.6	f) use copy stand to reproduce originals	Applying	

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
A.7, 8, B.8 C.3	g. use appropriate criteria to evaluate photographs.	Integrating	
	8. Process Photography		
A.6, M.5	a) operate process camera	Applying	
A.7, 8, B.8, C.2	b) size copy for reproduction	Applying	
A.6, C.1, 2, 3	c) expose and process a diffusion transfer (STAT)	Applying	
A.6, C.1, 2, 3	d) expose and process a line negative using lithography and/or rapid access films	Applying	
A.6, C.1, 2, 3	e) expose and process a halftone using diffusion transfer and/or film	Applying	
C.3, M.1	f) prepare chemicals for processing films	Applying	
A.5, 7, 8, B.8 C.3	g) evaluate finished film for proper exposure and processing.	Integrating	
	9. Film Image Assembly		
A.6, M.1	a) lay out a flat	Applying	
A.6, M.1	b) assemble a flat using appropriate techniques	Applying	
A.6, M.1	c) prepare a complimentary flat	Applying	
A.6, M.1	d) prepare a masking flat	Applying	
A.1, 7, 8, B.8 C.3	e) proof and evaluate flat.	Applying	
	10. Platemaking		
C.2, 3, M.1	a) determine appropriate plate material for job	Applying	
C.2, 3, M.1	b) determine proper plate exposure	Applying	
A.6, M.1	c) expose and process additive and subtractive plates	Applying	
A.6, M.1	d) expose and process electrostatic plates	Applying	
A.7, 8, B.8, C.3	e) evaluate plate.	Integrating	

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
	11. Presswork		
A.1, 3, 7, C.3	a) recognize safety aspects unique to press operation	Integrating	
A.6, C.1, 2	b) set up paper feeding/delivery/register system	Applying	
A.1, 7, C.3	c) select appropriate ink	Knowing	
A.6, C.1	d) prepare inking system	Applying	
A.6, C.1	e) prepare dampening system	Applying	
A.1, 7, 8, B.8 C.3	f) proof and evaluate copy	Integrating	
A.6, M.1	g) produce finished copy	Applying	
A.6, C.1, M.1	h) clean and maintain press.	Applying	
	12. Paper		
A.2, 4, M.1	a) identify different paper manufacturing processes	Knowing	
A.2, 4, M.1	b) identify types of paper	Knowing	
A.5, 7, C.2	c) recognize standard sizes and weights of paper	Knowing	
A.5, 7, C.1	d) select paper appropriate to job.	Applying	
	13. Ink		
A.2, 4, C.3	a) describe types and uses of inks	Knowing	
A.1, 5, C.2, 3	b) select appropriate ink for job.	Applying	
	14. Bindery/Finishing Operations		
C.2, 3	a) select appropriate finishing operations	Integrating	
A.5, 6	b) cut/trim paper to size	Applying	
A.6, M.1	c) assemble (gather, collate, drill, bind, and fold) into a finished product	Applying	
A.5, 6, 8, B.8	d) mount materials	Applying	
A.5, 6, M.1	e) package finished materials for delivery.	Applying	

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
	15. Job Costing		
A.1, 5, 7, C.2, 3	a) assess client needs	Integrating	
A.1, 5, C.2	b) identify component costs	Knowing	
A.1, 5, C.2	c) estimate cost based on projected materials to be used	Applying	
A.2, 5	d) complete job ticket	Applying	
A.1, 5, 7, 8 C.1, 2, 3	e) evaluate disparity between estimated and actual cost of finished product	Integrating	
A.1, 5, C.1, M.1	f) adjust future estimates based on actual job data.	Integrating	
	16. Screen Printing		
A.7	a) identify printing projects typically screen printed	Knowing	
A.6, B.8, C.1 M.1	b) prepare original through appropriate copy preparation procedures	Applying	
A.6, 7, C.3	c) select fabric and prepare frame	Applying	
A.6, 7, C.1, M.1	d) prepare, process, and mask screen	Applying	
A.1, 5, 6, 7	e) select and prepare ink	Applying	
A.6, L.1, M.1	f) print job	Applying	
A.6, L.1, M.1	g) complete necessary finishing operations.	Applying	
	17. Safety		
A.7, B.6, C.1 L.1	a) practice appropriate safety procedures relative to area of study/equipment used	Applying, Affective	
A.1, 7, B.6, C.1	b) identify procedures for handling and disposing of hazardous materials	Knowing, Affective	
B.6, 7, 10, C.1	c) analyze environmental impacts of ink types, recycled paper, and waste disposal.	Integrating	
	18. Occupational Information		
B.9, I.1, 2 J.6, K.4, 5, M.4	a) name ten careers in communications/media and briefly describe the duties of each	Knowing, Affective	

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
A.7, B.11, M.2 M.4	b) identify job–entry requirements for careers in graphic communication.	Knowing	
	19. Gifted/Talented Outcomes		
A.6, 7, B.8 C.1, 2, 3	a) design and print a four–color poster to convey a specific message	Knowing, Applying Integrating Affective	
B.8, M.1, 5	b) assemble a portfolio of completed projects.	Applying	

Machine Shop

Program components shall include: blueprint reading; identification of metal; technical manuals; basic metallurgy; bench work; drilling; grinding; sawing; feeds and speeds; cutting tools; lathe operation; milling operations; precision grinding; non–traditional machining; heat treating; occupational information.

Learning experiences concerned with metal properties, machining, and heat treating.

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
	1. Safety		
	Students will be able to:		
L.1, 5	a) determine proper attire for safe working conditions	Knowing, Applying	
A.6, C.1, L.1 L.5, M.1	b) perform tasks according to industrial safety standards	Applying, Affective	
A.6, C.1, M.1	c) maintain proper adjustment of tool rests and guards	Applying	
C.1	d) demonstrate knowledge of basic first aid procedures.	Applying	
	2. Precision Measurement		
A.5, C.1, 2, 3	a) identify the importance of close tolerancing in modern machining	Knowing	
A.6, C.1, M.1	b) demonstrate proper use and care of standard precision measuring devices, e.g., micrometers, slide calipers, dial indicators, and gauges.	Applying	
	3. Apply Computational Skills		
A.5	a) apply basic mathematics	Applying	
A.5, C.1, 3	b) estimate materials, time, and costs	Applying	
A.5, C.2	c) use formulas to solve a variety of machining–related computational problems.	Applying Integrating	
	4. Blueprint Reading		
A.5, C.1	a) recognize and interpret lines, views, dimensions, and symbols	Knowing	
A.5	b) recognize the concept of geometric tolerancing.	Knowing	

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
	5. Resource Materials		
C.1, 2	a) interpret and use charts, tables, and specifications	Integrating	
C.1, 2	b) interpret and use technical learner's manuals.	Integrating	
	6. Basic Metallurgy		
A.1, 3, 7, C.2	a) identify common ferrous and nonferrous metals and alloys	Knowing	
A.2, 4, C.3	b) describe properties of metals, e.g., hardness, tensile strength, elasticity, machinability, compressive strength, ductility, shear strength, and heat conductivity.	Knowing	
	7. Bench Work		
A.7, C.2	a) identify common bench tools	Knowing	
A.6, C.1, 2, 3 L.1, M.1	b) use common bench tools properly	Applying	
A.6, C.1, M.1	c) perform basic bench tool operations such as filing, sawing, threading.	Applying	
	8. Coolants and Lubricants		
A.7, C.2	a) identify coolants and lubricants	Knowing	
A.6, 7, C.3	b) select proper cutting fluids for each application	Applying	
A.6, C.1, M.1	c) perform proper machine lubrication as per schedule.	Applying	
	9. Feeds and Speeds		
A.7, C.2	a) identify cutting speeds for various materials	Knowing	
A.5, C.1	b) calculate proper RPM for the machine	Applying	
A.5, C.1	c) calculate proper feed for the machine.	Applying	
	10. Cutting Tools		
A.6, 7, C.3	a) select appropriate cutting tool for task to be performed	Applying	

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
A.6, C.1, M.1	b) perform appropriate sharpening operation for cutting tools	Applying	
A.7, C.1, 2, 3	c) evaluate cutting tool performance and correct as necessary.	Integrating	
	11. Drilling		
A.7, C.2	a) identify common drilling equipment	Knowing	
A.6, C.1, M.1	b) perform common drilling operations	Applying	
A.6, 7, C.3	c) select proper drilling tools, e.g., drill bits, counter sinks, reamers, and tap drills.	Applying	
	12. Grinding		
A.7, C.2	a) identify types of abrasives	Knowing	
A.7, C.2	b) identify types of grinding equipment	Knowing	
A.6, 7, C.3	c) select grinding wheel for job	Applying	
A.6, C.1, M.1	d) perform rough grinding operations	Applying	
A.6, C.1, M.1	e) perform tool sharpening to specifications.	Applying	
	13. Sawing		
A.7, C.2	a) identify types of power sawing equipment	Knowing	
A.6, 7, C.3	b) select proper blade for job	Applying	
A.6, C.1, M.1	c) perform proper cutting procedures for shape of material.	Applying	
	14. Lathe Operation		
A.7, C.2	a) identify common metal turning machines	Knowing	
A.6, 7, C.1, M.1	b) select and use proper work-holding devices, e.g., between centers, three– and four–jaw chucks, and collets	Applying	
A.6, 7, C.1, 2 M.1	c) perform setups for lathe operations such as facing, drilling, turning, taper turning, knurling, and threading	Applying	
A.6, C.1, M.1	d) perform the above lathe operations to specifications	Applying Integrating	

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
A.7, C.1, 2, 3	e) evaluate the finished product according to specifications.	Integrating	
	15. Milling Operations		
A.7, C.2	a) identify common milling equipment	Knowing	
A.5, 6, 7, C.1	b) mount and align a vise on a mill	Applying	
A.6, C.1, M.1	c) true in the head on a vertical mill	Applying	
A.6, 7, C.1	d) select and use proper work-holding devices	Applying	
A.6, C.1, M.1	e) perform the setup operations for various materials and cutters	Applying	
A.6, C.1, M.1	f) perform milling operations such as surfacing, fly cutting, slots, keyways, angles, drilling, tapping, reaming, boring, and indexing	Applying	
C.1, 2, 3	g) evaluate the finished product according to specifications.	Integrating	
	16. Precision Grinding		
A.7, C.2	a) identify common precision grinding machines, e.g., surface grinder, cylindrical grinder, centerless grinder, tool and cutter grinder, and internal grinder	Knowing	
A.6, 7, C.1, M.1	b) select proper grinding wheel for the job	Applying	
A.6, C.1, M.1, 5	c) perform surface grinding operations such as dressing wheel, mounting work, and plain grinding flat surfaces	Applying	
C.1, 2, 3	d) evaluate surface and size of finished product according to specifications.	Integrating	
	17. New Machining Technologies		
A.2, 4, 7, C.2	a) describe the operation, applications, and advantages of computer numerical controls	Knowing	
A.2, 4, 7, C.2	b) describe the following types of machining processes: electrical discharge machining, laser machining, powder metallurgy, electro–beam machining, and chemical machining	Knowing	

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
A.1, 3, C.1	c) describe the function of robots in manufacturing.	Knowing	
	18. Heat Treating		
A.2, 4, 7, C.2	a) describe common heat treating processes such as hardening, tempering, annealing, case hardening, and flame hardening	Knowing	
A.6, C.1, M.1, 5	b) perform common heat treating procedures.	Applying	
	19. Environment		
	a) Select materials, processes, equipment and cutting fluids with environmental considerations in mind	Knowing, Affective International/Global	
	b) Analyze impacts of machine process selected, recycling, waste disposal methods, and air pollution.	Knowing, Affective International/Global	
	20. Occupational Information		
B.9, I.1, 2, J.6 K.4, 5, M.4	a) name ten machine trades–related careers and briefly describe the duties of each	Knowing	
A.7, B.11, M.2 M.4	b) research current job market information in machining occupations	Integrating	
B.3, D.1, 2, 3 F.2, 3	c) demonstrate appropriate work ethic	Applying	
A.7, B.11, M.2 M.4	d) identify job entry requirements for careers in the machine trades.	Knowing	
	21. Gifted/Talented Outcomes		
A.5, 6, B.8 C.1, 2, 3	a) design a product and the necessary tooling to mass produce that item	Knowing, Applying Integrating	
A.6, M.1, 2 M.5, 6	b) master a machining process through extensive practice or purposeful repetition	Knowing, Applying Psychomotor	
A.5, 6, B.8, C.1 C.2, 3, M.1, 5	c) design a machineable product using CAD; write a CAM program to produce that product.	Knowing, Applying Integrating	

Mechanical Drafting

Mechanical Drafting Occupations. Learning experiences concerned with visual communications skills to convey ideas and specifications necessary to manufacture or reproduce mechanical items.

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
	1. Equipment and Materials		
	Students will be able to:		
A.6, 7, C.1	a) select appropriate drawing tools, e.g., lead holders, lead, technical pens, compasses, and erasers	Applying	
A.6, 7, C.3	b) select appropriate drawing medium, e.g., paper, vellum, mylar, and sepia	Applying	
A.6, C.1, M.1	c) operate drafting machines, e.g., track, elbow, and parallel bar	Applying	
A.6	d) operate reproduction equipment.	Applying	
	2. References and Standards		
A.1, 5, 7, C.1 M.1	a) follow appropriate drafting standards by consulting references such as *The Machinery Handbook, ANSI Standards,* and *McGrey*	Knowing, Applying	
A.6, C.1	b) use appropriate line weights and types to complete drawings	Applying	
A.6, M.1, 5	c) letter quickly and legibly according to industry standards	Applying	
A.2, 5, C.2	d) use standard drawing symbols to designate objects, details, and appropriate information	Applying	
A.5, C.1	e) determine appropriate scale and sheet layout	Applying Integrating	
C.1, 2	f) read and interpret blueprints.	Applying, Integrating	
	3. Using Mathematical Principles and Geometric Constructions		
A.5	a) apply adding, subtracting, multiplying, and dividing of whole numbers, fractions, decimals, and percentages to solve problems	Applying Integrating	
A.5	b) solve mathematical problems such as area, volume, weight, and calculation of angles	Applying	

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
A.5	c) convert between fractions and decimals, and between English and metric units	Applying Integrating	
A.5, 6, C.1	d) use geometric construction procedures to divide lines, arcs, and circles	Applying	
A.5, 6, C.1	e) use geometric construction procedures to construct parallel, perpendicular, and tangent lines	Applying	
A.5, 6, C.1	f) use geometric construction procedures to construct arcs, circles, curves, ellipses, and polygons.	Applying	
	4. Sketches, Pictorial Drawings, Renderings, and Technical Illustrations		
A.2, 5, C.1 M.1 M.5	a) produce orthographic and pictorial sketches	Applying	
A.6, 8, B.8, C.1	b) produce pictorial drawings, e.g., axiometric, oblique, perspective, and isometric	Applying	
A.6, 8, B.8	c) produce renderings or technical illustrations using accepted design principles.	Applying	
	5. Dimensions and Tolerances		
C.1	a) read common drafting scales, e.g., architectural, engineering, and metric	Knowing	
A.5, C.1	b) use fractional, decimal, and metric units to show sizes, dimensions, and tolerances as appropriate	Applying Integrating	
C.1, M.1	c) use notes, flags, and balloons to provide necessary information or detail	Applying	
C.1, M.1	d) use aligned and unidirectional dimensions as appropriate.	Applying	
	6. Computers and Related Equipment		
A.6	a) operate input devices such as graphic tablet, mouse, and keyboard	Applying	
A.6	b) operate output devices such as plotter, printer, and CRT	Applying	

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
A.7, C.2	c) compare computer equipment capabilities, e.g., speed, memory	Integrating	
A.1, 7, C.3	d) identify software characteristics such as speed, cost, capability, compatibility, ease of learning, flexibility, user friendliness, and expandability	Knowing, Integrating	
A.6, C.1, 2, 3 M.1, 5	e) construct a CAD drawing of an object	Applying	
A.6, C.1, 2, 3 M.1, 5	f) use computers and appropriate software to estimate projects, produce material lists, complete engineering computations, provide simulations, solve rendering and shading problems, and word processing.	Applying	
	7. Design, Problem Solving, and Model Construction		
B.3, D.1, 2, 3	a) produce solutions to design problems assigned or encountered	Applying	
A.2, 4, 8, B.8	b) present design solutions orally, in writing, or in graphic form as appropriate	Applying	
A.6, C.1, 2, 3 M.1, 5	c) construct models or a design layout.	Applying	
	8. Mechanical Drawings		
A.6, C.3, M.1, 5	a) use orthographic projection procedures to draw mechanical objects	Applying	
A.6, C.3, M.1, 5	b) use auxiliary views to describe objects or features which cannot otherwise be shown or described	Applying	
A.6, C.3, M.1, 5	c) use sectional views to describe objects or features which cannot otherwise be shown or described	Applying	
	d) draw selected fastening devices	Applying	
A.6, C.3, M.1, 5	e) use assembly drawings to show the relationships of mechanical parts which fit or fasten together	Applying	
A.7, C.2, M.1	f) identify applications of working drawings	Knowing	

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
A.6, C.1, M.1, 5	g) complete a working drawing which will be used to build a product	Applying	
A.2, 5, 6, C.1 M.1, 5	h) create charts, graphs, and flow diagrams	Applying Integrating	
A.2, 5, 6, C.1 M.1, 5	i) construct surface development drawings	Applying	
A.2, 5, 7, C.1, 2 C.3	j) use standard practices to complete bills of material and specifications	Applying	
A.2, 4, 5	k) provide appropriate oral and written communication to support drawings completed.	Applying	
	9. Occupational Information		
B.9, I.1, 2, J.6 K.4, 5, M.4	a) name ten careers related to architectural drawing and briefly describe the duties of each	Knowing	
A.7, B.11, M.2 M.4	b) describe job responsibilities of professionals at several levels, e.g., detailer, drafter, estimator, designer, lead person	Knowing	
A.2, 4, C.1, M.1	c) describe how drafters interrelate with other occupations to produce a product	Knowing	
M.2, 3, 4	d) discuss trends in the drafting industry.	Knowing	
	10. Gifted/Talented Outcomes		
A.6, C.1, 2, 3	a) develop enhanced skills of visualization and spatial perception through designing a complex mechanical product or structure	Knowing, Applying Integrating	
A.5, 6, M.1, 2, 3	b) design a machineable product using CAD; write a CAM program to produce the product.	Knowing, Applying Integrating	

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK

Small Engine Repair Occupations

Learning experiences concerned with the maintenance and repair of small engines, lawn and garden equipment, and recreational vehicles.

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
	1. Principles of Internal Combustion Engine Operation		
	Students will be able to:		
C.1	a) contrast types and characteristics of energy	Knowing	
C.2	b) identify forms of available energy	Knowing	
C.1	c) describe types of mechanical motion found in engines	Knowing	
A.2, 7, C.2	d) label components of basic internal combustion engines including two- and four-stroke cycle	Knowing	
C.1, 2	e) describe the process by which an internal combustion engine converts chemical energy into rotary motion	Knowing	
C.3	f) assess types of engine design	Integrating	
A.2, 4, C.1	g) explain characteristics and describe operation of two- and four-cycle engines	Knowing	
A.1, C.1	h) interpret model, type, and code numbers found on engines	Integrating	
A.7, C.3	i) identify operating positions of the crankshaft	Knowing	
A.7, C.1, 2	j) recognize factors that determine firing order of a multicylinder engine	Integrating	
C.1, 3	k) analyze the relationship between camshaft lobe, valve timing, and overlap	Integrating	
A.7, C.2	l) identify types of valve arrangements	Knowing	
A.7, C.1	m) identify factors which determine engine timing	Knowing	
A.7, C.2	m) identify exhaust systems and components.	Knowing	

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
	2. Gaskets and Sealants		
A.7, C.2	a) identify gasket materials, i.e., paper, rubber, cork, steel, and combinations	Knowing	
A.7, C.2	b) identify sealing compounds	Knowing	
A.1, 7, C.1	c) select and use appropriate gaskets and sealants	Applying	
A.1, 7, C.1	d) use technical information to determine proper tightening sequence and torque specifications.	Applying	
	3. Fasteners		
A.7, C.2	a) identify types and grades of fasteners	Knowing	
A.1, 5, 6, 7	b) measure standard/English and metric bolts and threads	Applying	
A.1, 5, 6, 7	c) identify types of washers	Applying	
A.4, C.1, M.1	d) demonstrate methods used to remove a seized nut or a broken bolt or stud	Applying	
A.4, C.1, M.1	e) demonstrate tools to restore internal and external threads.	Applying	
	4. Apply Computational Skills		
A.5	a) apply basic mathematics	Knowing, Applying	
A.5	b) estimate time and costs required to complete a repair	Applying	
C.1, 2	c) interpret charts, graphs, and tables	Applying	
C.1, 2	d) interpret precision measurement data	Integrating, Applying	
A.1, 2, 5, C.1	e) solve problems using the formulas for work, horsepower, and torque	Applying	
A.1, 2, 5, C.1	f) solve problems using the formulas for engine cubic inch displacement and compression ratio.	Applying	
	5. Measuring		
A.7, C.2	a) identify measuring instruments	Knowing	
A.4, 6, C.1	b) demonstrate correct use of precision tools	Knowing	

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
A.2, 4, 5	c) describe basic units of measurement	Knowing	
A.4, 5, 6, C.1	d) demonstrate steps for reading measuring instruments	Knowing	
A.1, 5, C.1	e) convert metric to conventional measurements and vice versa	Applying	
A.1, 5, 6, 7	f) perform measurements using a conventional or metric micrometer, digital micrometer, dial indicator, or telescoping gauge.	Applying	
	6. Electricity		
C.1	a) identify sources of electricity	Knowing	
A.2, 4, C.2	b) name parts of a basic circuit	Knowing	
A.2, C.2	c) list good conductors and insulators of electricity	Knowing	
A.7, C.3	d) differentiate between direct and alternating current	Integrating	
A.1, 7, C.2	e) interpret basic electrical schematic symbols	Integrating	
A.2, 4, 5, C.2	f) define Ohm's law by letter and formula	Knowing	
A.2, 4, C.2	g) name types of electrical circuits	Knowing	
A.1, 2, 5, C.2	h) solve problems using Ohm's law formula	Applying	
A.2, 4, C.2	i) describe rules for series circuits and parallel circuits	Knowing	
C.3	j) determine factors affecting resistance in a conductor	Integrating	
C.2	k) describe relationship between electricity and magnetism	Knowing	
A.1, 5, 6, 7	l) measure voltage, amperage, and resistance with instruments	Applying	
A.1, 5, 6, 7, C.1	m) check continuity with appropriate test equipment	Applying	
A.2, 4, C.3	n) describe charging systems	Knowing	
A.7, C.3	o) identify charging system components and functions	Knowing	

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
A.2, 4, C.2, 3	p) explain reverse polarity	Knowing	
A.6, C.1, M.1	q) remove and replace a generator/alternator	Applying	
A.6, C.1, M.1	r) disassemble, check, and reassemble a generator/alternator	Applying	
A.2, 4, C.3	s) describe types of starters	Knowing	
A.2, 4, C.2, 3	t) compare components of manual and electrical starting systems	Integrating	
A.6, 7, C.1, M.1	u) remove, disassemble, test, service, and reassemble a mechanical or electrical starter.	Applying	
	7. Ignition Systems		
A.2, 4, C.2, 3	a) explain purpose and operation of the ignition system	Knowing	
C.2	b) identify types of ignition systems	Knowing	
A.2, 4, 7, C.2, 3	c) differentiate between components of a primary and secondary battery ignition circuit	Integrating	
A.7, C.2	d) recognize components of the standard ignition system	Knowing	
A.7, C.3	e) analyze components of the magneto ignition system	Integrating	
A.7, C.3	f) analyze components of a solid state ignition system	Integrating	
A.7, C.2	g) recognize components of a breakerless ignition system	Knowing	
A.6, C.1, M.1	h) remove, service, and replace spark plugs	Applying	
A.6, C.1, M.1	i) remove and replace contact points and condenser	Applying	
A.6, C.1, M.1	j) test the coil, condenser, armature, and flywheel magnets	Applying	
A.6, C.1, M.1	k) test a solid state ignition system	Applying	
A.6, 7, C.1 C.2, 3, M.1	l) check and adjust ignition timing using a dial indicator or timing light.	Applying	

100

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
	8. Electronic Control Systems		
A.2, 4, C.2	a) identify components and describe their operation	Knowing	
A.6, C.1	b) use test equipment to diagnose system.	Applying, Integrating	
	9. Fuel and Induction Systems		
A.2, 4, C.2	a) describe purpose of the fuel system	Knowing	
C.2	b) identify basic types and components of fuel supply systems	Knowing	
A.2, 4, C.2	c) describe types of carburetors	Knowing	
A.2, 4, 7, C.1 M.1	d) identify and service fuel filters	Knowing	
A.7	e) recognize types of fuel pump action	Knowing	
A.2, 4, 7, C.1 M.1	f) identify and service air cleaners	Applying	
C.1, M.1	g) service a float or diaphragm-type carburetor	Applying	
A.6, 7, C.1 M.1	h) test and service a fuel pump	Applying	
A.2, C.2	i) list components of an electronic fuel injection system	Knowing	
A.6, 7, C.1 M.1	j) service the fuel delivery system on an electronic fuel injection engine.	Applying	
	10. Lubrication Systems		
A.2, 4, C.2, 3	a) explain types of lubrication systems	Knowing	
A.2, 4, C.2	b) describe purpose of the crankcase breather and service components	Knowing	
A.2, 4, C.3	c) define characteristics of a good lubricant, i.e., oil, grease	Knowing	
A.7, C.3	d) recognize oil specifications, i.e., SAE viscosity numbers, API classification system, oil additives	Knowing	
A.1, 7, C.1, 3	e) select and use oils for best engine performance following manufacturer's recommendation	Applying	

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
C.1, M.1	f) perform lubrication service and engine oil and filter change.	Applying	
	11. Cooling		
C.2	a) identify components of the cooling system	Knowing	
A.2, 4, C.2	b) describe functions of the cooling system	Integrating	
A.2, 4, C.2	c) describe causes of overheating	Knowing	
A.6, 7, C.1 M.1	d) inspect, remove, clean, and replace cooling system parts.	Applying	
	12. Governors		
A.2, 4, C.2	a) describe purpose of the governor	Integrating	
C.2	b) identify types of governor systems	Knowing	
A.7, C.2, 3	c) differentiate between components of governor systems and their purposes	Integrating	
A.6, 7, C.1 M.1	d) inspect, adjust, and repair a pneumatic or mechanically operated governor.	Applying Integrating	
	13. Exhaust Systems and Noise Control		
A.2, 4, C.2	a) describe danger of operating an engine in a closed shop	Knowing	
C.2	b) identify types of exhaust systems	Knowing	
A.7, C.2, 3	c) diagnose condition of exhaust system	Integrating	
A.6, 7, C.1, M	d) remove, service, and replace exhaust system components.	Applying	
	14. Air Pollution/Emissions		
A.2, 4, C.2, 3	a) describe past, present, and future trends in emission control devices	Knowing, Affective	
C.2, 3	b) identify harmful exhaust gases released into atmosphere	Knowing	
C.2, 3	c) identify how emissions are controlled at the crankcase, carburetor, fuel tank, and exhaust pipe	Knowing	
A.6, C.1, M.1	d) perform basic emissions tests	Knowing	

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
A.6, C.1, M.1	e) service emissions equipment on vehicle	Knowing	
B.6, 7, 10	f) analyze the impact of the internal combustion engine on the environment.	Integrating	
	15. Steering and Suspension		
A.5, C.2	a) identify tire size and type information	Knowing	
C.2	b) identify suspension components	Knowing	
A.2, 4, C.2, 3	c) describe function of suspension components	Knowing	
A.6, C.1, M.1	d) operate tire changing equipment	Applying	
A.6, C.1, M.1	e) remove and replace steering and suspension components.	Applying	
	16. Brakes		
A.7, C.2, 3	a) identify components and operation of brake systems	Knowing	
A.6, C.1, M.1	b) operate brake servicing equipment	Applying	
A.6, C.1, M.1	c) remove and replace components of brake systems	Applying	
A.6, C.1, M.1	d) adjust brakes.	Applying	
	17. Driveability/Performance		
A.7, C.2, 3	a) recognize common performance problems, i.e., hesitation, lack of power, fuel economy problems, and hard starting	Integrating	
C.2, 3	b) analyze problems using flow charts, trouble trees, and technical manuals	Integrating	
A.6, C.1, M.1	c) correct problems according to manufacturer's specifications.	Applying	
	18. Power Transfer/Transmission Systems		
C.2	a) identify types	Knowing	
A.2, 4, C.2	b) describe components and functions	Knowing	

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
A.6, C.1, M.1	c) diagnose and correct system malfunctions	Integrating	
A.6, C.1, M.1	d) service components.	Applying	
	19. Diagnostic and Testing Equipment		
A.7	a) recognize capabilities of various types of test equipment	Knowing	
A.6	b) connect test leads properly	Applying	
A.6, C.2	c) make accurate readings	Applying	
C.1, 2, 3	d) interpret readings from test equipment	Integrating	
A.6, 7, C.1, M.1	e) adjust, repair, or replace according to specifications.	Applying	
	20. Preventive Maintenance/Storage		
A.6, C.1, 2, 3 M.1	a) clean, lubricate, service, and/or replace components, i.e., filters, spark plugs, belts, bearings, and blades in accordance with owners manual	Applying	
A.6, C.1, M.1	b) perform recommended storage procedures, i.e., fuel systems, cooling systems, and lubrication	Applying	
A.6, C.1	c) dispose of waste fluids and materials according to government regulations.	Applying, Affective	
	21. Technical Manuals/Information Systems		
A.5, C.2	a) identify sources of technical information	Knowing	
C.1, 2, 3	b) interpret technical information	Integrating	
A.6, 7, C.1 C.2, 3	c) apply technical information to correct problems or restore to original performance specifications	Integrating	
A.1, 5	d) use flat rate manuals to determine repair costs.	Applying	
	22. Parts Management		
A.5, C.2	a) identify types of information found in parts catalogs	Knowing	

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
A.2, 4, C.2, 3	b) describe common parts and their abbreviations	Knowing	
A.2, 7, C.1	c) list steps in using a parts catalog	Knowing	
A.1, 2, 4, 5, 7 C.1	d) demonstrate how to price parts correctly	Knowing	
A.1, 2, 4, 7 C.1	e) use the microfiche system to identify a part	Applying	
A.2, 4, C.2, 3	f) describe uses for computers in inventory control, stocking, and pricing	Knowing	
A.2, 7, C.1	g) establish guidelines for completing a physical inventory	Integrating	
A.2, 5, 7, C.1	h) compile information and complete a service order.	Applying	
	23. Occupational Information		
B.9, I.1, 2, J.6 K.4, 5, M.4	a) name ten careers in small engine repair and briefly describe the duties of each.	Knowing, Affective	
	24. Gifted/Talented Outcomes		
A.6, 7, C.1 C.2, 3, M.1	a) participate with a team of students to design, build, and test a supermileage vehicle for competition at the state level	Knowing, Applying Psychomotor Affective	
A.6, 7, C.1 C.2, 3, M.1	b) identify the scientific principles present in a small engine carburetor	Knowing, Applying Integrating	
A.6, C.1, 2, 3 M.1	c) redesign a small engine for maximum fuel efficiency	Knowing, Applying Integrating	
A.6, C.1, 2, 3 M.1	d) modify a small engine to reduce pollution	Knowing, Applying Integrating Affective	
A.6, C.1, 2, 3 M.1	e) design a system to capture and use the heat produced by a stationery gasoline engine.	Knowing, Applying Integrating Affective	

Technology Cooperative Program

Learning experiences which expand knowledge and skill gained in technology subject areas, and with the competencies attained through school–employer partnerships that will help learners succeed while employed in the technology sector.

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
	1. Career Awareness and Planning		
	Students will be able to:		
B.9, 11, M.2	a) appraise a variety of career options related to their employment goals	Integrating	
K.5, M.6	b) assess career interests and aptitudes	Integrating	
A.1, C.2, 3	c) develop a tentative career plan, including preparation options of work experience, military, apprenticeship, college/university, and public and private vocational colleges and institutes	Applying	
M.4	d) use on–the–job training to explore a variety of careers	Knowing, Applying	
	2. Employability skills		
B.9, J.1, K.5	a) demonstrate appropriate job–seeking skills, i.e., researching, networking, resumes, applications, interviewing, and business communications	Applying	
M.5, 6	b) demonstrate job–seeking skills such as positive attitudes, work habits, and relationships	Applying, Affective	
A.1, 2, 3, 4, 5 M.6	c) practice appropriate worksite communications skills, i.e., reading, writing, speaking, listening, technical vocabulary, and worksite communication technology	Applying Integrating	
A.1, 2, 3, 4, 5 C.1, 2, 3, M.1	d) apply thinking/reasoning skills to tasks performed at the job site.	Applying Integrating	
	3. Rules and Regulations		
B.12	a) comply with requirements for participation in an on–the–job training experience, e.g., age certificates, employer evaluations	Applying	

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
B.12, M.1	b) follow a training agreement developed by the instructor, employer, and parent or guardian	Applying	
B.12	c) demonstrate their knowledge of program and worksite expectations by complying with program policies, attendance, and and work rules.	Knowing, Applying	
	4. Safety		
L.1	a) demonstrate good safety knowledge attitudes by working in an accident–free manner	Applying, Affective	
A.1, C.1	b) explain regulations pertaining to OSHA, child labor laws, "Right to Know," and hazardous occupations	Knowing	
C.1, L.1	c) demonstrate a knowledge of first aid procedures	Applying	
L.1	d) define good home, traffic, and leisure safety practices.	Knowing, Affective	
	5. The Training Station		
L.1, M.1, 3	a) apply safety, employability, leadership and academic skills taught in the school setting	Applying	
B.9, 11, M.4, 6	b) examine issues affecting job entry, advancement, mobility, and satisfaction	Integrating, Multicultural/ Gender Fair	
A.1, 2, 3, 4, 5 C.1, M.6	c) demonstrate general employment skills such as problem solving, attitude, cooperation and worksite vocabulary	Applying	
A.6	d) demonstrate specific job skills such as tool and equipment usage	Applying	
B.1, F.2	e) describe productivity and its relationship to employment security.	Knowing	
	6. Technology		
A.1, 2, 5, 6, M.1	a) apply principles of mathematics, science, and communications to perform the job	Applying	

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
A.6, B.1, M.1	b) use appropriate technology on the job, e.g., robotics, control devices, phone systems, analyzers, computers, and cash registers	Integrating	
A.6, B.1, C.1 C.2, 3, M.1	c) demonstrate competency in industrial computer application such as CAD, CNC, graphic character generation, lasers, microwave technology, and fiber optics	Applying	
A.6, B.1, C.1 C.2, 3, M.1	d) demonstrate a knowledge of systems such as thermal, mechanical, fluidal, and optic.	Applying	
	7. Citizenship		
L.1, 2, 3, 4	a) demonstrate responsible behavior regarding non–use/abuse of chemicals, i.e., drugs, alcohol, and smoking	Applying, Affective	
K.2, 3, 4, M.6	b) distinguish among factors which affect self–esteem	Integrating Affective	
B.3, D.1, 2, 3 F.2, 3	c) demonstrate respect for clients, customers, and co–workers of diverse cultures and both genders, including persons with disabilities	Applying Multicultural/ Gender Fair	
M.3	d) volunteer for community service activities.	Applying, Affective	
	8. Personal Finance		
J.2, 3, 4, K.5 M.4	a) develop financial goals which will substantiate desired lifestyle	Applying	
B.12	b) establish a checking or savings account at a bank	Applying	
B.12	c) establish credit or secure a loan from a bank	Applying	
B.12, J.2	d) examine various insurance plans/options/ needs, i.e., car, renter/homeowners, life, health	Integrating	
B.10	e) describe federal, state, local, and social security taxes and how they are collected and distributed	Knowing	
A.5, C.1	f) explain wages and benefits, including employer and employee contributions	Knowing	

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
A.5, C.1	g) describe components of financial planning, including short– and long–term investment options and risk factors	Knowing Integrating	
B.12, J.2	h) demonstrate independent living skills such as budgeting, housing, and transportation needs.	Applying	
	9. Individual Leadership/Development Skills		
C.1, M.3	a) use parliamentary procedure to participate and function effectively in meetings	Applying	
M.3	b) practice leadership and support roles	Applying	
B.1, J.3, K.3	c) demonstrate positive attitudes toward lifelong learning, self–direction, and initiative	Applying	
B.1, J.3, K.3	d) demonstrate an interest in learning to learn, including: • knowledge that learning is a lifelong process • the ability to demonstrate initiative and direct one's own learning activities	Applying	
A.1, 2, 3, 4, 5 A.6, C.1, 2, 3 J.6	e) demonstrate good thought processes and thinking skills in leadership and other roles.	Applying, Affective	
	10. Business Economics		
B.5, 10	a) explain characteristics of the global economy such as resources, products, political influences, and the labor market	Knowing Integrating International/Global	
B.10	b) describe business organizational structures, such as corporations, partnerships, and sole proprietorships	Knowing	
K.4, 5, M.5	c) identify skills and knowledge associated with self–employment/entrepreneurship, i.e., product/service, sales/marketing, patent/copyright, legal aspects, and risk/initiative	Knowing Integrating	
J.6, K.2, M.6	d) describe rights, responsibilities, and organizations associated with labor in union and non–union settings	Knowing, Affective	

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
B.11, C.3, D.2	e) describe rights, responsibilities, and trends associated with management	Knowing	
B.4, 5	f) identify principles of basic workplace economics, i.e., productivity, supply/ demand, employee theft and shoplifting, pay equity, and salary negotiations.	Knowing	
	11. Environmental Issues		
B.6, 7	a) list issues related to the local, national, and global environment	Knowing, Affective International/Global	
B.6, 7	b) identify personal responsibilities associated with environmental concerns.	Knowing Integrating Affective	

Welding Occupations

Program components shall include: blueprint reading; identification of metal; technical manuals; basic metallurgy; bench work; drilling; grinding; sawing; foundry; oxy–fuel welding and cutting; arc welding; electrode/filler metal selection; inert gas welding; occupational information.

Learning experiences concerned with metal properties, machining, and heat treating.

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
	1. Safety		
	Students will be able to:		
L.1, 5	a) determine proper attire for safe working conditions	Applying	
A.6, C.1, L.1, 5 M.1	b) perform tasks according to industrial safety standards	Applying	
A.6, C.1, M.1	c) maintain proper adjustment of tool rests and guards	Applying	
C.1	d) demonstrate knowledge of basic first aid procedures.	Integrating	
	2. Blueprint Reading		
A.6, C.1, M.1	a) perform basic layout operations	Applying	
A.1, 5, 7, C.3	b) recognize and interpret lines, views, dimensions, and symbols	Knowing	
A.5, C.1	c) recognize the concept of geometric tolerancing.	Knowing	
	3. Apply Computational Skills		
A.5	a) apply basic mathematics	Applying	
A.5, C.1, 3	b) estimate materials, time, and costs	Applying	
A.5, C.2	c) use formulas to solve welding–related computational problems.	Applying	
	4. Resource Materials		
C.1, 2	a) interpret and use charts, tables, and specifications	Integrating	
C.1, 2	b) interpret and use technical manuals.	Integrating	

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
	5. Basic Metallurgy		
A.1, 3, 7, C.2	a) identify common ferrous and nonferrous metals and alloys	Knowing	
A.2, 4, C.3	b) describe properties of metals, e.g., hardness, tensile strength, elasticity, machinability, compressive strength, ductility, shear strength, and heat conductivity.	Knowing	
	6. Bench Work		
A.7, C.2	a) identify common bench tools	Knowing	
A.6, C.1, 2, 3 L.1, M.1	b) use common bench tools properly	Applying	
A.6, C.1, M.1	c) perform basic bench tool operations such as filing, sawing, threading.	Applying	
	7. Coolants and Lubricants		
A.7, C.2	a) identify coolants and lubricants	Knowing	
A.6, 7, C.3	b) select proper cutting fluids for each application	Applying	
A.6, C.1, M.1	c) perform proper machine lubrication as per schedule.	Applying	
	8. Feeds and Speeds		
A.7, C.2	a) identify cutting speeds for various materials	Knowing	
A.5, C.1	b) calculate proper RPM for the machine	Applying	
A.5, C.1	c) calculate proper feed for the machine.	Applying	
	9. Drilling		
A.7, C.2	a) identify common drilling equipment	Knowing	
A.6, C.1, M.1	b) perform common drilling operations	Applying	
A.6, 7, C.3	c) select proper drilling tools, e.g., drill bits, counter sinks, reamers, and tap drills.	Applying	
	10. Grinding		
A.7, C.2	a) identify types of abrasives	Knowing	
A.7, C.2	b) identify types of grinding equipment	Knowing	

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
A.6, 7, C.3	c) select grinding wheel for job	Applying	
A.6, C.1, M.1	d) perform rough grinding operations	Applying	
A.6, C.1, M.1	e) perform tool sharpening to specifications.	Applying	
	11. Sawing		
A.7, C.2	a) identify types of power sawing equipment	Knowing	
A.6, 7, C.3	b) select proper blade for job	Applying	
A.6, C.1, M.1	c) perform proper cutting procedures for shape of material.	Applying	
	12. Heat Treating		
A.2, 4, 7, C.2	a) describe common heat treating processes such as hardening, tempering, annealing, case hardening, and flame hardening	Knowing	
A.6, C.1, M.1	b) perform common heat treating procedures.	Applying	
	13. Foundry		
A.2, 4, 7, C.2	a) describe types of foundry patterns	Knowing	
A.7, C.2	b) identify common foundry molds	Knowing	
A.6, C.1, M.1, 5	c) perform the procedures necessary to produce a sand mold	Applying	
A.6, C.1, M.1, 5	d) pour molten metals to perform casting	Applying	
C.1, 2, 3	e) evaluate cast product.	Integrating	
	14. Electrode/Filler Metal Selection		
A.2, 4, C.2	a) define terms such as tensile strength, polarity, welding position, and flux	Knowing	
C.1, 2, 3	b) interpret data from American Welding Society electrode selection chart	Integrating	
A.7, C.1, M.1	c) use above information to select proper electrode for task to be performed.	Integrating	
	15. Oxy–fuel Weld and Cut		
A.6, C.1	a) setup and adjust equipment	Applying	
A.6, C.1	b) prepare metal for welding	Applying	

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
A.7, C.2	c) identify common operations such as soldering, brazing, flame cutting, and fusion welding	Knowing	
A.6, C.1, M.1	d) describe techniques to control distortion	Applying	
A.6, C.1, M.1	e) perform soldering, brazing, flame cutting, and fusion welding to complete tasks	Applying	
A.7, C.3	f) inspect and test weld coupons.	Knowing	
	16. Arc Welding		
A.6, C.1	a) set up machine and welding station	Applying	
A.6, C.1	b) prepare metal for welding	Applying	
A.3, 5, 7, C.2	c) select proper electrode and perform machine adjustments	Applying	
C.1, 2, 3	d) describe techniques to control distortion	Knowing	
A.6, C.1, M.1, 5	e) perform necessary welds in various positions to complete tasks	Applying Psychomotor	
A.7, C.1, 2, 3	f) identify common welding errors caused by travel speed, arc length, electrode angle, and incorrect amperage setting	Knowing	
A.7, C.3	g) inspect and test weld coupons.	Knowing Integrating	
	17. Inert Gas Welding		
A.7, C.3	a) identify common types of inert gas welding such as MIG (metallic inert gas), TIG (tungsten inert gas), and plasma arc	Knowing	
A.2, 4, C.2	b) describe common applications of metal inert gas, tungsten inert gas, and plasma arc welding	Knowing	
A.6, C.1	c) prepare metal for welding	Applying	
A.5, 7, C.1	d) perform machine adjustments MIG, TIG, and plasma arc welding equipment	Applying	
C.1, 2, 3	e) describe techniques to control distortion	Knowing	

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
A.6, C.1, M.1	f) perform practice welds in various positions to complete tasks, using one or more of: MIG, TIG, and plasma arc welding	Applying Psychomotor	
A.6, C.1, 2, 3	g) evaluate, inspect, and test weld coupons.	Integrating	
	18. New Welding Technologies		
A.1, 3, C.1	a) describe the use of robotics in welding applications	Knowing	
A.1, 3, C.1	b) describe the use of lasers in welding applications.	Knowing	
	19. Environment		
A.2, 4, C.2, 3	a) select materials, processes, and equipment with environmental considerations in mind	Knowing Affective International/Global	
C.2, 3	b) analyze impacts of welding process selected, recycling, waste disposal methods, and air pollution.	Integrating Affective	
	20. Occupational Information		
B.9, I.1, 2, J.6 K.4, 5, M.4	a) identify ten welding–related careers and briefly describe the duties of each	Knowing	
A.7, B.11, M.2, 4	b) research current job market information in welding occupations	Integrating	
B.3, D.1, 2, 3 F.2, 3	c) demonstrate appropriate work ethic	Applying	
A.7, B.11, M.2, 4	d) identify job entry requirements for careers in welding.	Knowing	
	21. Gifted/Talented Outcomes		
A.5, 6, B.8, C.1 C.2, 3, M.1, 5	a) design a product and the necessary tooling to mass produce that item	Knowing, Applying Integrating Psychomotor	
A.6, M.1, 2, 5, 6	b) master a welding process through extensive practice or purposeful repetition.	Knowing, Applying Integrating Psychomotor	

General Outcomes for All Areas

STATE BOARD LEARNER GOALS	LEARNER OUTCOMES	DEVELOPMENT AND CONCEPT EMPHASIS	TEST ITEM BANK
	Students will be able to:		
A, B.2, 3, 5, D E, F, G, I, J L.5, M	1. demonstrate leadership, human relations skills, and a positive self-concept through participation in Vocational Industrial Clubs of America (VICA), Technology Student Assocation (TSA), or other appropriate student organization	Applying International/Global Multicultural Gender Fair	
B.3, D.1, 2, 3 F.2, 3	2. demonstrate respect for clients, customers, and co-workers of diverse cultures and both genders, including persons with disabilities	Multicultural Gender Fair	
A, C, M.1	3. apply skills related to higher order thinking, including observing, inferring, using numbers, measuring, predicting, communicating, formulating hypotheses, using common mathematical and scientific symbols, interpreting data, and identifying and controlling variables	Applying Integrating	
B.4, 5, 6, 7, 10	4. recognize that technology itself is neutral, but that the use to which it is put may provide positive or negative results or benefits.	Knowing Integrating	

Chapter 4

Technology Education/ Industrial Technology

Transposing Outcomes into the Curriculum

Chapter Four

Transposing Outcomes Into Curriculum

The learner outcomes in this document were developed to aid educators in formulating goals and objectives at the local level for technology education/industrial technology. Statewide committees of teachers from this field developed listings of terminal learner outcomes (Chapter 3). As materials were being developed and refined, committee members were encouraged to solicit input from advisory committee members and others outside of education. This chapter provides examples of transposing outcomes into curriculum. Materials in this document are coordinated with the Minnesota Plan for Industrial Technology Education which consists of the following five documents: 1) a planning guide; 2) communication technology; 3) energy and power utilization technology; 4) production technology; and 5) transportation technology. A basic understanding of the philosophical direction provided by the Minnesota Plan for Industrial Technology Education and the five documents which comprise this plan is necessary for implementation of the learner outcomes in this document. These materials and their source are detailed in the bibliography.

Meeting the Needs of All Learners

Adaptive education provides for unique learners, including disability–sensitive, gifted and talented, or both. The emphasis of adaptive education services is to examine the instructional program and develop a more appropriate fit between the individual characteristics of the learner and learning experiences the student will encounter. The goal of adaptive education services is to modify and enrich the student's learning experiences to promote student achievement. Adaptive education services are necessary for exceptional students because it is unlikely that learning experiences planned for most students will be as effective for them due to their great range of individual differences. In fact, in some cases the "regular educational program" may actually inhibit or reduce the student's chances of success in school.

Service to Students with Disabilities

Adaptive education services include both the modification of instruction strategies, methods and materials, and the development of new experiences which capitalize on individual student strengths. The matching of individual students with appropriate instructional activities requires knowledge of the student, his or her educational needs, preferred learning style, the outcomes to be accomplished, the logical modification or extensions in the field, and the method of delivery.

For example, a visually impaired student may require the use of tactile materials to understand a shape or design.

Sometimes an individual who has a disability is also gifted and talented. In this case, both the modification and the extension should be provided.

Service to Gifted and Talented Students

There is an active process to identify and place gifted and talented students in appropriate educational services. An individualized learning plan is devised and monitored for a student which provides for a modification of the student's instructional program, promotes cognitive or affective development, and involves a more intensive program of services which may not be offered through the modification of the student's regular classroom experiences.

Gifted and talented students may exhibit the following characteristics: 1) show early or advanced mastery of content or skills; 2) show an unusual competency or creativity with technological phenomenon or processes; 3) exhibit persistence and demonstrate creativity in productive work; 4) work independently; and 5) participate in competitions and challenges in technical areas.

The following represents criteria for service to gifted and talented students:

1. There is an active process to identify and place gifted and talented students in appropriate educational services. Efforts must be employed to ensure representation and participation of all student populations in gifted and talented services. Individuals of all races, creeds, national origins, genders, physical handicaps, or economic status should be served in similar percentages as they are represented in the total student population.

2. Courses and/or learning experiences are designed which include the following modifications: credit is given for prior learning, "regular" instructional activities are reduced or replaced with challenging tasks and learning experiences, or offered activities which capitalize on student strengths or talent areas.

Process

We recommend that each district establish a specific set of procedures by which staff can transpose the districtwide outcomes into classroom scope and sequence.

There are two issues that must be considered in the design of these products.

> The purpose of the procedures is to provide each teacher with information regarding what is expected of students in terms of learning for that grade or class. The aim is alignment of outcomes and instruction.
>
> It is critical that the procedures not be cumbersome or onerous and equally critical that they be sufficiently specific to achieve their purpose.

There are five key elements to such a procedure. They include:

1. Specification of outcomes.
2. Specification of the standard for student performance (objective).
3. Specification of whether the instruction is for awareness, emphasis, or reinforcement.
4. Teacher design of the instruction in terms of methods, activities, and media.
5. Monitoring implementation of the instruction.

The following procedure is very specific and detailed. Each district should review this process and adapt it to meet the situation with consideration of the issues described above.

Selection of Learner Outcomes

1. The Technology Education/Industrial Technology staff should select learner outcomes from *Model Learner Outcomes for Technology Education / Industrial Technology* in addition to writing their own outcomes. Outcomes should reflect the district mission statement and goals from the Minnesota Plan for Industrial Technology Education.

2. The selected outcomes along with the rationale for their selection should be taken to a PER committee or other body representing community input. Depending on district policy, this step should be coordinated with the building principal, curriculum coordinator, and/or superintendent.

3. Use Curriculum Development Form One to list all outcomes of a course. Forms One through Three with directions are on pages 107 through 118.

4. Present the outcomes to the local Board of Education for adoption by the district.

5. Using Form One, complete Curriculum Development Form Two. Examples are provided at the end of this chapter. They illustrate how the outcome would be developed to the objective level.

6. Form Three provides a list of methods necessary to achieve the Technology Education/Industrial Technology learner outcomes.

The following pages contain the three curriculum development forms with instructions. They are followed by three examples of Technology Education/Industrial Technology outcomes that have been expanded using the recommended curriculum development forms.

It is recommended that the Minnesota Plan for Industrial Technology Education be used as a basis for curriculum development. It is further recommended that course offerings be coordinated and articulated with courses of a similar title or content which are offered at an earlier grade level, and with postsecondary offerings a student might be likely to attend.

INSTRUCTIONS FOR CURRICULUM DEVELOPMENT — FORM ONE

LINE

A. Enter subject area.

COLUMN

1. List all outcomes for the subject in a sequence determined by the grade-level grouping in which initial awareness-level instruction is to be provided.

2. Enter a reference code to the district's learner goal(s) that justifies inclusion of the outcome.

3. Enter an "A" in the column that indicates the grade levels in which awareness instruction is provided.

   Enter an "E" in the column that indicates the grade levels in which emphasis instruction is provided.

   Enter an "M" in the column that indicates the grade levels in which mastery attainment is expected.

   Enter an "R" in the column that indicates the grade levels in which reinforcement instruction is provided.

CURRICULUM DEVELOPMENT FORM ONE

A. SUBJECT
Technology Education/Industrial Technology

1. OUTCOME/RELATED PROBLEM Assist students in assessing and preparing for current and emerging occupations equipment.	**2.**	**3. GRADE-LEVEL ASSIGNMENT**							
		a 6	b 7	c 8	d 9	e 10	f 11	g 12	h
Identify ten different transportation careers.		X	X	X					
Recognize ways in which transportation systems are used in the areas of Energy & Power Use, Communication, and Production.		X	X	X					
Produce various devices needed to transport goods and people within the four transportation environments.					X	X			
Compare modes of transportation.					X	X			
Analyze technical data and apply it to transportation problems.					X	X			
Construct a transportation vehicle with a structural, propulsion, and control system.					X	X			
Identify types of ignition systems.							X	X	
Remove, service, and replace spark plugs.							X	X	
		A	A		E	E	M	M	

X Transportation Technology Curriculum Guide from
Minnesota Plan for Industrial Technology Education

INSTRUCTIONS FOR CURRICULUM DEVELOPMENT — FORM TWO

BOX

A. Enter subject area.

B. Enter the grade level or course to which the form applies.

C. Circle one or more as appropriate:

A = Awareness Instruction
E = Emphasis Instruction
M = Student Mastery
R = Reinforcement Instruction

D. Enter the complete outcome.

COLUMN

1. In consideration of the assignment, list the clusters for which instruction is to be provided at the grade level.

2. List the subclusters of each cluster necessary to provide instruction to the level of assignment. There may be no subclusters for some cluster.

3. **Complete only if the assignment is student mastery.** Write the subclusters in measureable terms.

CURRICULUM DEVELOPMENT FORM TWO

A. SUBJECT Technology Education/ Industrial Technology	**GRADE LEVEL OR COURSE** High School	**ASSIGNMENT** A E [✓ M] R

D. OUTCOME/RELATED PROBLEM
Assist students in assessing and preparing for current and emerging occupations.

1. Cluster/ Subrelated Problem	**2. Subclusters/ Major Concepts**	**3. Objectives**
The student will be able to service ignition systems.	1. Explain purpose and operations of the ignition system.	1. Explain concepts of voltage, amperage, and resistance as applied to ignition system. Differentiate between components of primary and secondary battery ignition circuit.
	2. Identify types of ignition systems.	2. Be able to recognize standard ignition system, magneto ignition system, and breakerless ignition system. Be able to explain why various types of vehicles/ engines use different ignition systems.
	3. Service components of a standard ignition system.	3. Remove and replace ignition points and condenser. Remove, service, and replace spark plugs. Inspect distributor cap. Inspect cables and connections.

INSTRUCTIONS FOR CURRICULUM DEVELOPMENT — FORM THREE

BOX

A. Enter subject area.

B. Enter the grade level or course to which the form applies.

C. Circle one or more as appropriate:

A = Awareness Instruction
E = Emphasis Instruction
M = Student Mastery
R = Reinforcement Instruction

D. Enter one cluster for the outcome. Complete this only if there are subclusters written for the cluster.

COLUMN

1. Enter one cluster if no subclusters are written; **or**

   Enter a subcluster if no objective is written; **or**

   Enter an objective.

2. Enter the quarter of the year in which instruction is to be provided.

3. Describe methods, materials, and media to be used to provide instruction. (Example on following page.)

CURRICULUM DEVELOPMENT FORM THREE		
A. SUBJECT Technology Education/ Industrial Technology	**GRADE LEVEL OR COURSE** High School	**ASSIGNMENT** A E M R
D. OUTCOME/RELATED PROBLEM		
E. CLUSTER/SUBRELATED PROBLEM		
1. CLUSTER, SUBCLUSTER, OR OBJECTIVE	2. QUARTERS IN WHICH INSTRUCTION IS TO BE PROVIDED	3. METHODS - MATERIALS* - MEDIA*
		Reading and studying Observing and describing concepts Observe demonstrations Comparing and contrasting concepts Discussing/dialoguing Recognizing and categorizing design/drafting processes Producing drawings Interpreting drawings Solving design problems Using appropriate computer programs

INSTRUCTIONS FOR CURRICULUM DEVELOPMENT — FORM ONE

LINE

A. Enter subject area.

COLUMN

1. List all outcomes for the subject in a sequence determined by the grade-level grouping in which initial awareness-level instruction is to be provided.

2. Enter a reference code to the district's learner goal(s) that justifies inclusion of the outcome.

3. Enter an "A" in the column that indicates the grade levels in which awareness instruction is provided.

   Enter an "E" in the column that indicates the grade levels in which emphasis instruction is provided.

   Enter an "M" in the column that indicates the grade levels in which mastery attainment is expected.

   Enter an "R" in the column that indicates the grade levels in which reinforcement instruction is provided.

CURRICULUM DEVELOPMENT FORM ONE

A. SUBJECT
Technology Education/Industrial Technology

1. OUTCOME/RELATED PROBLEM Prepare students to work with technical systems within the areas of communication, production, transportation, and energy/power use.	**2.**	**3. GRADE-LEVEL ASSIGNMENT**							
		a	b	c	d	e	f	g	h
		6	7	8	9	10	11	12	

INSTRUCTIONS FOR CURRICULUM DEVELOPMENT — FORM TWO

BOX

A. Enter subject area.

B. Enter the grade level or course to which the form applies.

C. Circle one or more as appropriate:

A = Awareness Instruction
E = Emphasis Instruction
M = Student Mastery
R = Reinforcement Instruction

D. Enter the complete outcome.

COLUMN

1. In consideration of the assignment, list the clusters for which instruction is to be provided at the grade level.

2. List the subclusters of each cluster necessary to provide instruction to the level of assignment. There may be no subclusters for some cluster.

3. **Complete only if the assignment is student mastery.** Write the subclusters in measureable terms.

CURRICULUM DEVELOPMENT FORM TWO

A. SUBJECT	GRADE LEVEL OR COURSE	ASSIGNMENT
Technology Education/ Industrial Technology	High School	A E [✓ M] R

D. OUTCOME/RELATED PROBLEM

Prepare students to work with technical systems within the areas of communication, production, transportation, and energy/power use.

1. Cluster/ Subrelated Problem	2. Subclusters/ Major Concepts	3. Objectives
The student will be able to communicate effectively through design and drafting activities.	1. Describe how drafters interrelate with other occupations to produce a product.	1. Describe responsibilities of designers, detailers, estimators, toolmakers, moldmakers, and production designers.
	2. Use orthographic projection procedures to draw mechanical objects.	2. Produce, detail, and assemble drawings. Use sectional views and auxiliary views to show details.
	3. Produce preliminary design drawings for a residential or light commercial building.	3. Construct floor plan drawings. Use elevations and sections to show exterior appearances and details. Prepare cost estimates. Evaluate structural heat losses.

INSTRUCTIONS FOR CURRICULUM DEVELOPMENT — FORM THREE

BOX

A. Enter subject area.

B. Enter the grade level or course to which the form applies.

C. Circle one or more as appropriate:

A = Awareness Instruction
E = Emphasis Instruction
M = Student Mastery
R = Reinforcement Instruction

D. Enter one cluster for the outcome. Complete this only if there are subclusters written for the cluster.

COLUMN

1. Enter one cluster if no subclusters are written; **or**

   Enter a subcluster if no objective is written; **or**

   Enter an objective.

2. Enter the quarter of the year in which instruction is to be provided.

3. Describe methods, materials, and media to be used to provide instruction.

CURRICULUM DEVELOPMENT FORM THREE

A. SUBJECT Technology Education/ Industrial Technology	**GRADE LEVEL OR COURSE** High School	**ASSIGNMENT** A E M R

D. OUTCOME/RELATED PROBLEM
Prepare students to work with technical systems within the areas of communication, production, transportation, and energy/power use.

E. CLUSTER/SUBRELATED PROBLEM

1. CLUSTER, SUBCLUSTER, OR OBJECTIVE	2. QUARTERS IN WHICH INSTRUCTION IS TO BE PROVIDED	3. METHODS - MATERIALS* - MEDIA*
		Reading and studying Observing and describing concepts Comparing and contrasting concepts Discussing/dialoguing Recognizing and categorizing design/drafting processes Producing drawings Interpreting drawings Solving design problems *Suggested learning materials and suggestions are identified in the communication technology section of the Minnesota Plan for Industrial Technology Education.

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Technology Education/ Industrial Technology

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